WIRELESS ENGINEER

THE JOURNAL OF RADIO RESEARCH & PROGRESS

DECEMBER 1954

VOL. 31 No. 12 THREE SHILLINGS AND SIXPENCE

A remarkable photograph by Eric Hosking, F.R.P.S., of a newly hatched Avocet.

JUST HATCHED

An entirely new "Avo" Signal Generator has been developed and production will commence in the near future. The new instrument has a wide frequency coverage and has been specially designed to meet the requirements of the existing and proposed new Television and Frequency Modulation stations.

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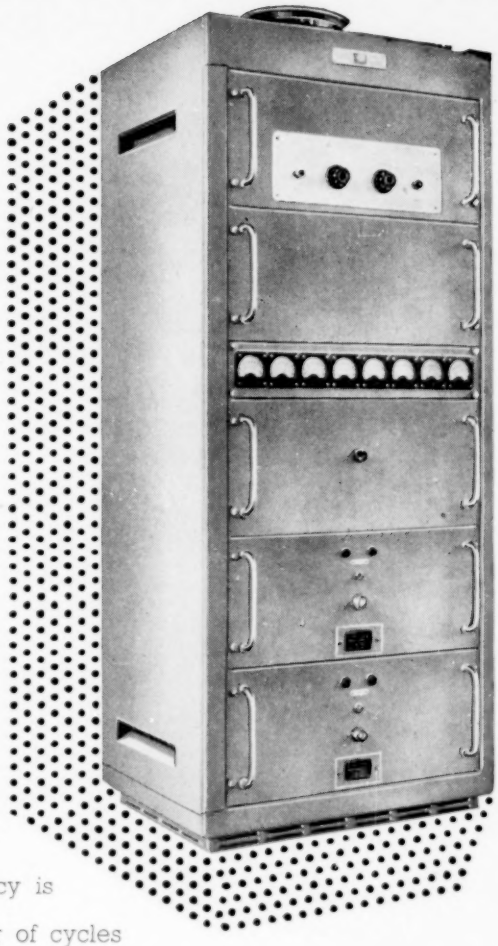

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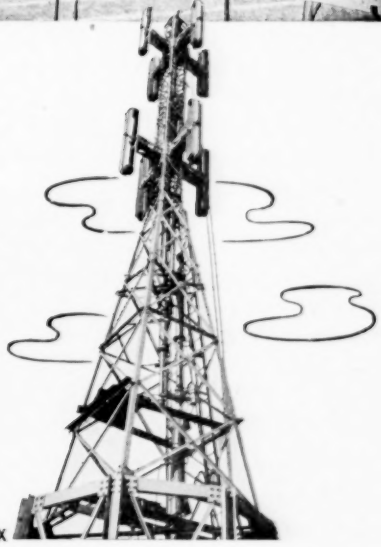

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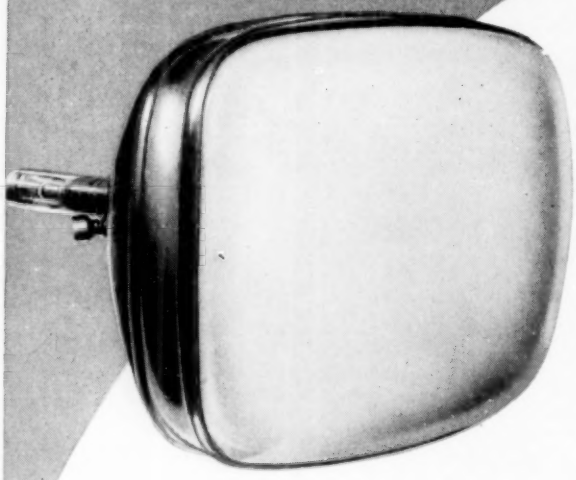
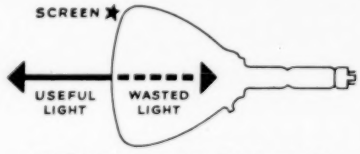
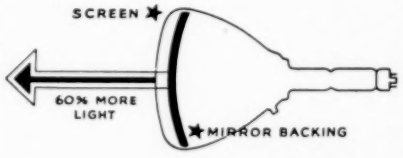


60% brighter pictures
more contrast
extra tube life



WITHOUT ALUMINIZING

Without aluminizing, tubes waste half their light (see diagram above). To counteract this the brilliance must be increased and the tube life is shortened.



WITH EDISWAN ALUMINIZING

Ediswan aluminized tubes have a mirror backing to the screen. All the light is thus thrown forwards giving brighter, clearer pictures and extra life.

AN Ediswan Mazda aluminized picture tube gives a picture 60% brighter and more contrasty than is possible with an ordinary tube.

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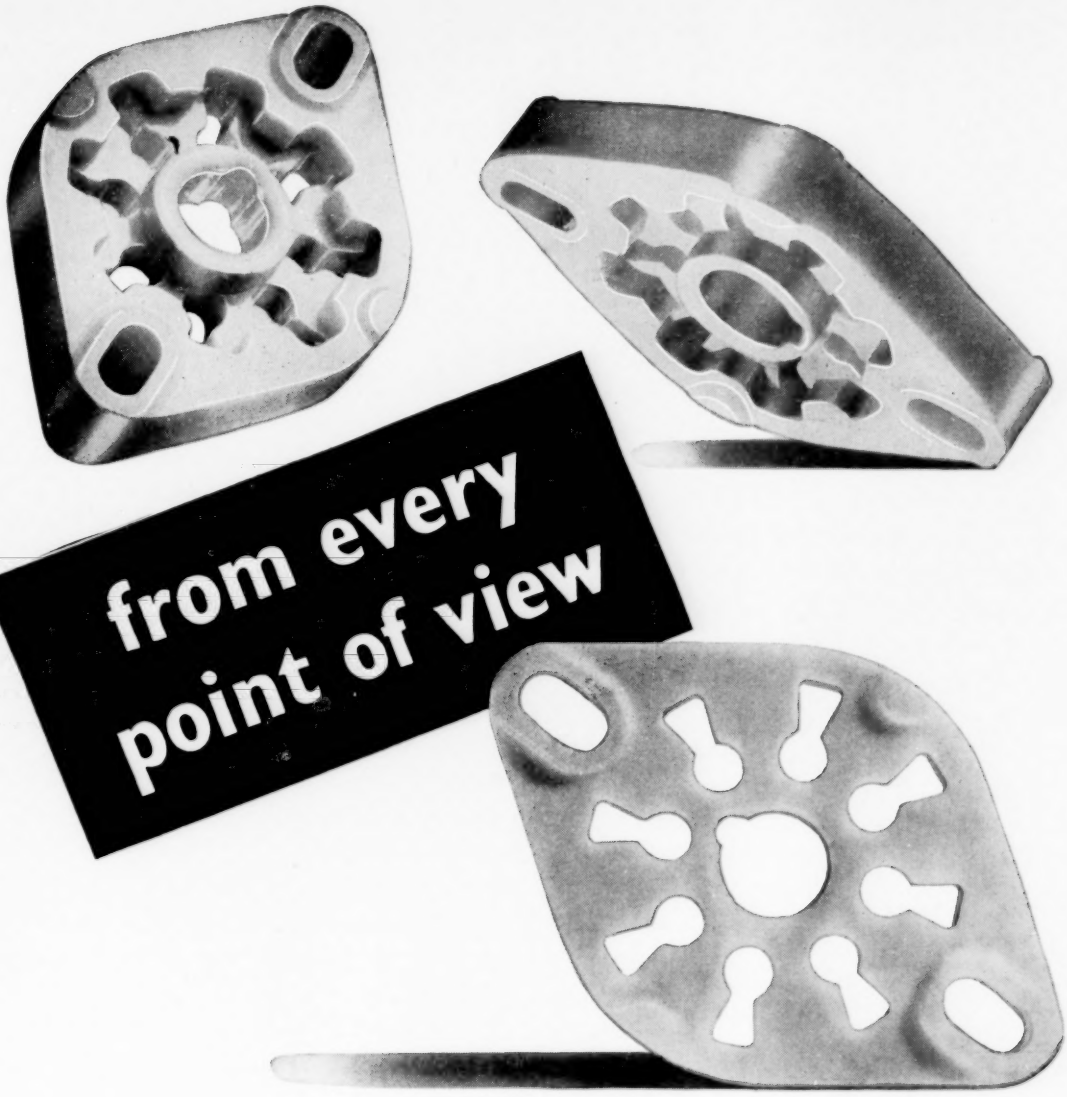

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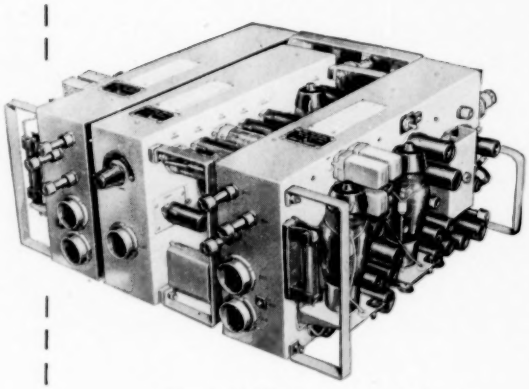

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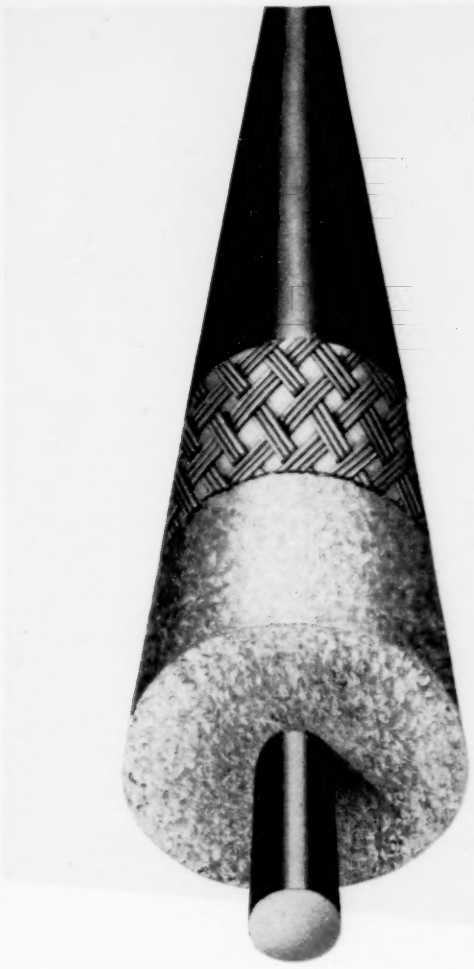

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less attenuation with only small increase in size

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136

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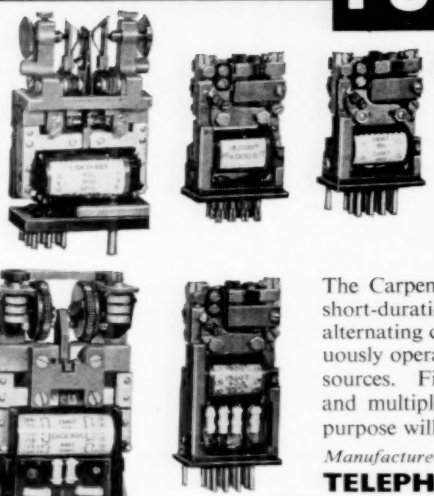

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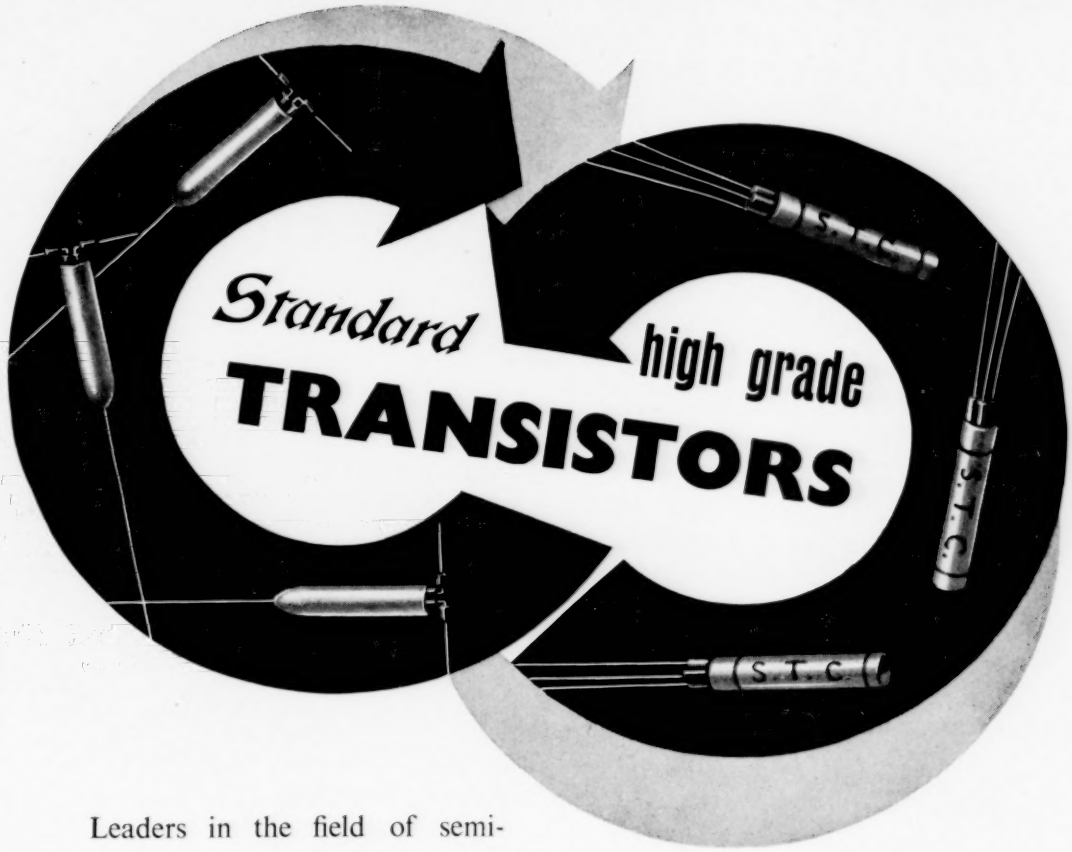

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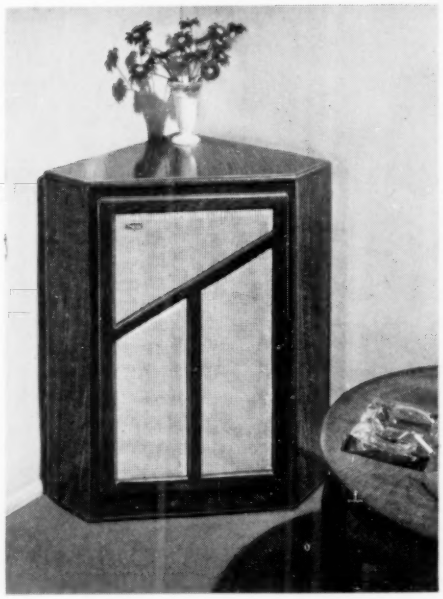

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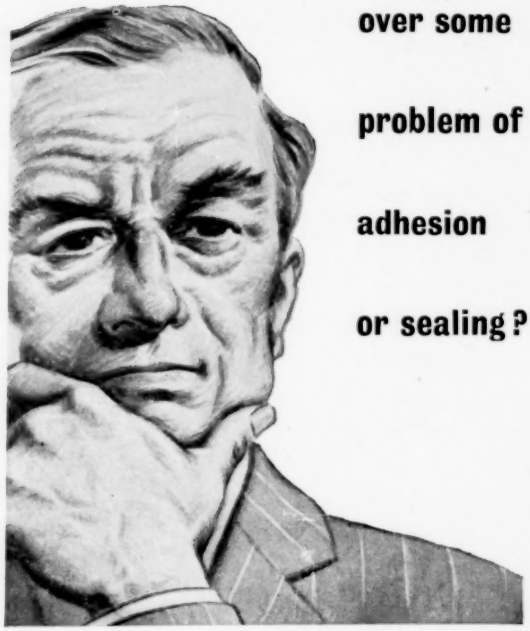

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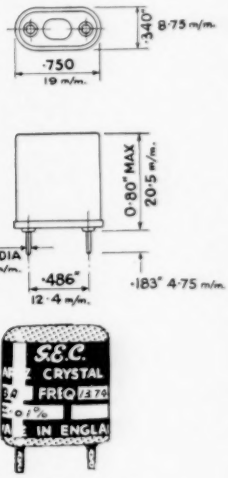

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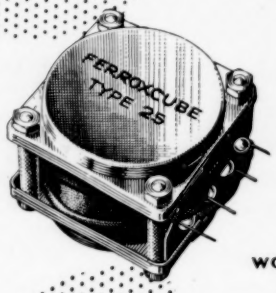

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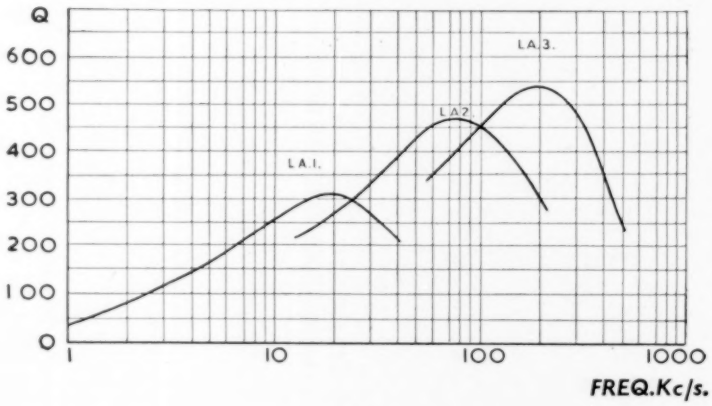

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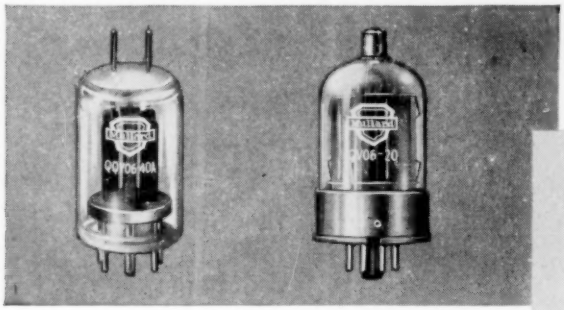

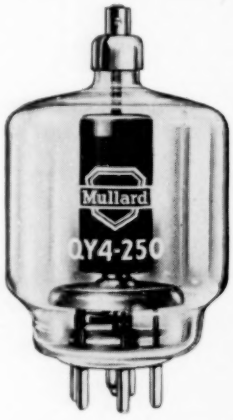

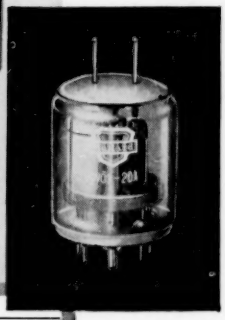

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QQV03-20A	6252	CV2799	V.H.F. Power double Tetrode	B7A	6·3 12·6	1·3 0·65	600	2x10	39 15	200 600
QQV06-40A	5894A	CV2797	V.H.F. Power double Tetrode	B7A	6·3 12·6	1·8 0·9	600	2x20	72 45	200 500
QY3-125	4-125A	CV2130	V.H.F. Power Tetrode	B5F	5·0	6·5	3000	125	300	120
QY4-250	4-250A	CV2131	V.H.F. Power Tetrode	B5F	5·0	14	4000	250	800	75
QV1-150A	4X-150A	CV2519	V.H.F. Power Tetrode	B8F	6·0	2·6	1250	150	156 112	165 500
QY5-3000A	6076	CV6076	V.H.F. Power Tetrode	Special 4-pin	6·3	32·5	5000	3000	3300 *3500	75 220

* 2 Valves in push-pull. Television service.

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The Life of Transmitting Valves

SOME very interesting points were discussed in an article by T. N. Basnett in the *Proceedings of the Australian Institution of Radio Engineers* for July, dealing with the causes of valve failure and the steps that can be taken to increase the life of transmitting valves. In considering emission and filament failures one must differentiate between pure tungsten, thoriated tungsten and oxide-coated cathodes. With pure tungsten the operating temperature is so high that contaminants are quickly removed and poisoning is rarely observed; any gas released in the bulb, or entering by infinitesimal leaks, is taken up by the tungsten, and failure is generally due to burn-out of the filament. The working temperature is limited by evaporation, which reduces the cross-section of the filament, but not, of course, with strict uniformity; the thinner parts will reach higher temperatures and evaporate more rapidly until finally, at a thin point, the metal at the centre of the wire melts and the wire separates with a droplet on one end. The life can be increased almost indefinitely by working at a lower temperature but, of course, at the sacrifice of emission. At 90% of the normal voltage the life of the valve is quadrupled, but the emission is reduced to 45%; it is therefore advisable to use the lowest filament temperature consistent with satisfactory operation.

If one switches on suddenly with the full voltage, the current will jump momentarily to 15 times its normal value, and the mechanical forces on the filament may do considerable damage; to avoid this, the initial current should be limited to little more than the normal current. For the same reason it is advisable to avoid switching the filament current off and on as much as possible; even if the valve is to be out of action for two hours, it is advisable to reduce the filament current to, say, 80% of its normal value, at which evaporation is negligible, rather than switch it off.

In thoriated tungsten filaments the emission depends on a surface layer of thorium atoms, the maintenance of which requires a rigid control of the temperature, which is above the melting point of thorium. The thorium diffuses to the surface, the outer layers of which consist of tungsten carbide, which is very brittle and contributes little to the strength of the filament, although it may constitute about a quarter of the cross-section. Thoriated filaments are operated at a considerably lower temperature than pure tungsten filaments and the evaporation of tungsten is negligible. The layer of carbide is necessary for the diffusion of the thorium, and failure of emission is usually due to decarbonization caused by too high a temperature; if the temperature is not high enough the thorium layer may not be maintained; it is obvious therefore that the filament temperature must be kept within close limits.

With oxide-coated cathodes it is also necessary to maintain the correct operating temperature; if this is done, failure of emission is rarely due to the filament itself, but probably to gas pressure or damage to the oxide coating, either mechanical or due to some contaminant. If these are avoided, the life of the oxide-coated cathode can be regarded as almost infinite.

The cause of valve failure may be in the glass envelope with metal to glass seals. The tempera-

ture gradients in the glass due to radiation from the electrodes, and the heating of the seals from the leads passing through them, will set up stresses. There is the danger due to electrolysis or moisture attacking the metal oxide which forms the bond between the metal and the glass of the seal. When heated, the glass is not a perfect insulator but may act as an electrolyte and deposit material which damages the seal. This may cause a failure of the seal or a crack in the glass. It is therefore very important to maintain effective cooling of the valve; it is suggested that in the neighbourhood of a seal the temperature of the glass should not exceed 150°C and that elsewhere it should not exceed 250°C.

The storage and handling of valves is also discussed. Apart from such obvious things as the avoidance of shock, vibration, and scratching, it is recommended that valves should be stored in a dry place and not exposed to sunlight. They should not be left on the shelf too long, as moisture may attack the seals, and gas may accumulate due to internal liberation or to small leaks. It is suggested that working and spare valves should be periodically changed over, or the spares operated occasionally for a few hours, thus eliminating any gas before it has accumulated to a degree that might damage the filament on heating it. It is stated that considerable work is being done on the reduction of these dangers by the use of protective coatings and moisture-tight packing. G. W. O. H.

GENERAL PROPERTIES OF ELECTROMAGNETIC AMPLIFIERS

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(Electrical Engineering Department, University of Birmingham)

SUMMARY.—The paper discusses the general relations between gain, bandwidth or time-constant, and power rating of amplifiers, together with the effects which may in principle be expected from the application of feedback. Examples are drawn from thermionic valves, magnetic amplifiers and rotating-machine amplifiers. It is pointed out that devices for improving the shape of the pass-band normally involve *delay*, and that distributed amplifiers allow an improvement in gain-bandwidth but not in gain/time-constant.

1. Introduction

THIS paper has been prepared for two reasons: the author was interested in the similarities between the characteristics of apparently different types of amplifier, and there appeared to be a need for a systematic analysis of the behaviour of amplifiers in general and relations between such concepts as 'time-constant', 'bandwidth' and 'gain'. Another important topic is the extent to which these factors can or cannot be modified by feedback. A number of purely electrical characteristic properties of amplifiers and relations between these properties will be discussed in Section 2, some thermal and mechanical limitations in Section 3, and some factors arising in the combination of amplifiers into a complete system will be discussed in Section 4.

2. Electrical Characteristics of Amplifiers

2.1. *The Input Time-Constant*

It appears that all amplifiers work on the principle that a variation in stored *energy* in the input member controls the output *power*. The obvious example is the rotary machine used as an amplifier: magnetic energy is stored in the field system in order that the armature may transfer power from the mechanical drive to the output circuit. The magnetic amplifier (using transductors) is obviously very similar, and in the grid-controlled thermionic valve the electrostatic field energy in the grid–cathode capacitance controls the transfer of power from the anode battery to the anode load. It appears, however, that this factor extends beyond purely electromagnetic amplifiers (such as have just been cited) to electromechanical and purely mechanical amplifiers. In the old-fashioned 'microphone amplifier', consisting of a telephone-receiver movement connected mechanically to a carbon microphone, the pressure on the microphone will be applied against the elastic constraint of the telephone diaphragm or, failing that, against the elastic yield of the microphone granules (for unless there is some elastic force the system will not revert to normal when the stress is removed) and input energy stored in the elastic deformation* is associated with the electrical power output. Even in a purely mechanical amplifier such as a clutch (e.g., the capstan-type clutch

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*A little of the energy will also be stored in the magnetic field of the telephone receiver.

used in the mechanical 'torque amplifier') the pressure required to bring the clutch members together to transmit power will involve the storage of energy in elastic strains.

The schematic diagram of an amplifier operating in steady-state conditions is therefore as shown in Fig. 1, where signal *energy* S.E. applied to the amplifier A controls the flow of power from the source P to the load L. (This form makes it appear justifiable, after all, to refer to a thermionic valve as a 'valve', in the sense in which the term is used in hydraulic engineering.)

But an amplifier is normally a device in which input and output are like quantities, so that in a power amplifier the input must be reckoned as *power* and not *energy*. The difference between these two quantities is a factor of *time* and the relationship may be expressed as

$$\text{input power} \times \text{input circuit time-constant} = \text{input energy} \quad .. \quad .. \quad (1)$$

The input power will in fact come from a system which can be represented by a source impedance plus either a constant-current or a constant-voltage source, and the source impedance will make

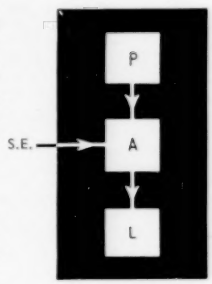

Fig. 1. *Amplifier A controls the power from the source P to the load L by a signal energy S.E.*

the time-constant of the complete input circuit differ from that of the amplifier alone. But by ignoring source impedance one can specify an input time-constant for the amplifier: this is exemplified in Figs. 2 and 3 for a thermionic valve and a rotary amplifier respectively, with a constant-current source of signal for the former and a constant voltage for the latter.

2.2. *An Ideal Amplifier has Infinite Gain at Zero Frequency*

Formula (1) can be extended, since output power is proportional to input energy, to read:

$$\text{input power} \times \text{input time-constant} = \text{input energy} = D \times \text{output power} \quad .. \quad (2)$$

where D is a constant of proportionality. It follows that if A is the power amplification,

$$A = \frac{\text{output power}}{\text{input power}} = (1/D) \times \text{input time-constant} \quad .. \quad (3)$$

and $A \rightarrow \infty$ as the input time-constant is increased without limit. In Fig. 2 there is nothing absurd in the idea of letting $R \rightarrow \infty$: in electrometer-valve applications it may be allowed to approach infinity so that small currents are measured as a rate of change of charge on C with leakage ignored. In Fig. 3 it appears impracticable to achieve a vanishingly small R, but L/R can be varied over a wide range. In any case, dissipation is required just in proportion to the rate of change of signal which is to be followed, or in more usual terminology, according to the bandwidth. *There is in principle no meaning or significance in a statement of gain unless the bandwidth is also specified.*

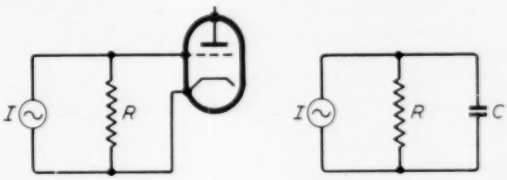

Fig. 2. *Input circuit of valve amplifier (a) and its equivalent (b).*

2.3. *A Real Amplifier has Maximum Gain over a Finite Band*

Considering only the input time-constant, the ideal amplifier has a decibel-gain versus log-frequency characteristic which is merely a straight line with slope of 6 db/octave. In a real amplifier, constructional defects involve a certain minimum dissipation and set a limit to this at some fairly low frequency; e.g., the input capacitance of a valve must be shunted by a grid-leak because of ion current, etc., to the grid, the winding of the field of a machine, or the control winding of a transductor, cannot be of zero resistance. The bandwidth of such an amplifier is often conventionally assumed to be limited at the frequency defined by the intersection of the two (extrapolated) straight-line parts of the characteristic as sketched in Fig. 4.

Fig. 3. *Simple rotary amplifier (a) and its equivalent (b).*

2.4. *The Maximum Value of Gain-Bandwidth Integral of an Amplifying Stage is determined when the Parasitic Reactance is known*

Individual cases may require separate treatment under this heading, since the proposition is phrased in terms of a single parasitic reactance

while in fact amplifiers have two parasitic reactances, one associated with the input and one with the output. (See Section 2.5 below.) In a cascade of amplifying stages it is possible to combine the output circuit of one with the input of the next to form a single 'interstage circuit', and the limitations of such circuits have been detailed by Bode[1].

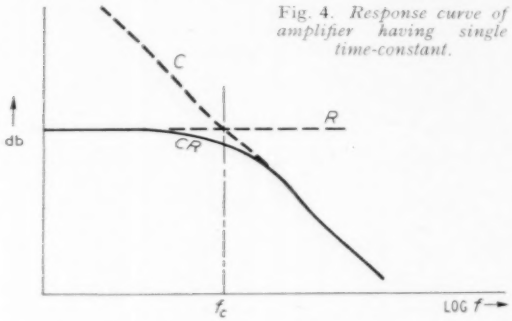

Fig. 4. *Response curve of amplifier having single time-constant.*

If dissipative elements are added, the total gain-integral is naturally reduced, as in Fig. 4, where the gain of the CR characteristic is less than that of the pure C characteristic. By the use of sufficiently complicated non-dissipative networks it is in principle possible to concentrate most of the gain within a specified frequency band, but the gain-integral over all frequencies will be the same as for C alone (Bode, Ch.17, Sections 17.1 and 17.2).

For this purpose the interstage coupling in high-frequency valve amplifiers is sometimes designed as a four-terminal impedance, of which the simplest form is sketched in Fig. 5(a) where R_1C_1 represent the output impedance of one valve and C_2R_2 the input impedance of the following valve. This is better than lumping the two reactances together, but again the degree of concentration of gain in the desired band depends on the degree of complexity of the coupling circuit, and the limit on the performance is given by Bode (p. 442) in the form that the maximum transfer impedance which can be realized over a given band is not greater than $\pi^2/2$ times the impedance of C for the given band, where C is the sum of the two capacitances.

In valve amplifiers the two capacitances C_1 and C_2 of Fig. 5(a) are usually approximately equal, which simplifies the design: for if C_1 and C_2 were substantially different it would be necessary to include a transformer or its equivalent in order to include the two different values of capacitance in a common filter section. Now it is in principle equally possible to apply this four-terminal coupling circuit to rotary machine amplifiers* simply by constructing the dual circuit as shown in Fig. 5(b). But the input reactance of a machine (inductance of the field circuit) is likely to be considerably greater than its output reactance (inductance of the armature) which means that the optimum four-terminal coupling network would include a transformer; and this fact, together with the low value of capacitive reactance involved at the low working frequencies, discourages the use of this system.

2.5. *The Gain-Bandwidth Integral of an Amplifier is unaffected by Feedback*

Bode states (p. 285): "In a single loop feedback amplifier of more than one stage the average regeneration or degeneration over the complete frequency spectrum is zero". From his derivation, it is clear that when Bode says 'more than one stage' he means 'more than one time-constant'. For the special case of a particular valve amplifier Bode felt justified in assuming that only one time-constant was significant, the other being so much smaller that it could be ignored in the working frequency range. This is not generally true, and the proposition basically applies to a single-stage amplifier as much as to a multi-stage amplifier. The fact that every amplifier has both an input time-constant and an output time-constant is often overlooked. When dealing with valve amplifiers it has often been concealed by lumping together the output capacitance of one stage with the input capacitance of the next, and in rotary machine amplifiers the significance of the

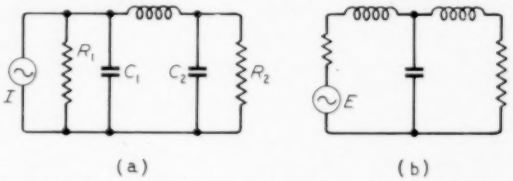

Fig. 5. *Four-terminal interval coupling (a) and equivalent for a rotary machine (b).*

output reactance compared with the input reactance is liable to be masked by the difference in impedance level. The permeance of the magnetic circuit of the armature is roughly one-third of that of the field[2] so that on a 'per squared turn' basis the armature inductance would be one-third of the field inductance. But a machine is usually designed for larger current and fewer turns on the armature, so that the absolute value of armature inductance is fairly low. The length of turn is about the same, and the copper/insulation space factor is usually better in windings of few turns, so the L/R of the armature is likely to be not less than one-third of the L/R of the field. But a further factor is that machines intended to be

*This point was brought to the author's notice by Mr. J. T. Allanson.

used as generators are designed to work at high efficiency (i.e., with the external load resistance much greater than the resistance of the armature winding) so that the time-constant of the complete output circuit may be much less than that of the armature alone.

Since feedback cannot change the gain-bandwidth integral, its function is solely to redistribute the gain between different frequencies. Precisely the same result can, in principle, be achieved by adding reactances to the circuit, but the use of feedback may sometimes be practically simpler. At high frequencies it is usually possible to construct fairly elaborate inter-stage networks of reactive elements in order to concentrate the gain in the desired band, but at low frequencies and high powers (e.g., 0–20 c/s and kilowatts with rotary amplifiers) reactors are too bulky to be acceptable. It is then preferable to use feedback of time-derivatives of the output so that additional current delivered by the machine itself to the circuit simulates the presence of additional reactances in the circuit.

In terms which will be familiar to radio engineers, it may be said that the amplifying device is used simultaneously both as an amplifier and as a reactance-simulator (cf. the 'reactance-valve' in one system of frequency-modulating an oscillator) to take the place of a physical reactor in the external circuit. The equivalence of the two systems, derivative feedback and the introduction of reactances, has virtually been demonstrated by Gouriet[3,4] who advocates the former in preference to the latter. Feedback cannot be expected to have much effect unless the gain without feedback is appreciable, so the feedback only controls the part of the spectrum for which there is a net gain (positive value in decibels or greater than unity as a ratio). The function of feedback can also be described as the 'transfer of responsibility'; i.e., making one part of a system responsible for the frequency response and linearity of another part. This is a familiar concept in the use of negative feedback to combat harmonic distortion arising in the output stage of a multi-valve amplifier, or to control the frequency response of a multi-stage amplifier. It must also apply to a single-stage amplifier, so that feedback is beneficial to the frequency response of a single-stage amplifier only if either the output or input circuit has a much shorter time-constant than the other.

2.6. *The Gain-Bandwidth Integral of an Amplifier is a Figure of Merit of the Device in Question and depends on the Specific Stressing of the Materials used in its Construction*

It follows from Sections 2.4 and 2.5 that the gain-bandwidth integral of any given amplifier has a specific value which cannot be exceeded by any system of circuitry; and the magnitude of this figure of merit is proportional to the stressing of the materials used in the construction of the amplifier. (The function of circuitry is to place the maximum practicable proportion of the gain in the desired pass-band). Some care may be needed in applying this rule to single stages, where either the output time-constant or the input time-constant can be disguised by the impedance of the load or source, but if necessary this can be taken into account in determining the specification for a given purpose. For example, the operation of the output circuit of a rotary amplifier at high power-efficiency implies a gross mismatch to the load which may in effect suppress the output time-constant.

In a thermionic valve the gain-bandwidth is controlled by g_m/C (where C is the sum of input and output capacitances) and there are three ways of increasing g_m:

(a) By increasing all the dimensions of the valve. This likewise increases C so that the gain-bandwidth is not increased.

(b) By reducing the anode resistance of the valve. This implies a high current density in a fixed size of electrodes which increases the specific electrical loading of the cathode and the thermal loading of the anode.

(c) By increasing the amplification factor at constant current. This requires a reduction in grid–cathode spacing which imposes a higher degree of mechanical precision on the structure as well as raising grid temperature. (The latter will affect the maximum zero-frequency gain since grid-emission limits the permissible resistance of grid–cathode circuit.)

In a transductor without self-excitation the power gain is closely proportional to $\omega L/R$ where L is the inductance and R the *direct current* resistance of the control winding, since the output inductance is equal to the input inductance when all quantities are expressed on the basis of 'per turn-squared'. Since L/R is the time-constant it seems that the only way to increase the gain-bandwidth integral is to raise the frequency, which may be regarded as an increase in the stressing of the iron since it will tend to produce greater iron loss which may be partly avoided by finer lamination of the core. (But the factor of proportionality between gain/time-constant and L/R is a function of the nonlinear magnetization régime; and the performance can be enormously improved by including a further nonlinear element, namely a rectifier, in the circuit. This is a feature of the 'half-cycle' magnetic amplifiers described by Ramey[5].)

A similar argument applies to a rotary amplifier, with increase of angular velocity corresponding to increase of supply frequency to the magnetic amplifier, but here there is additionally the increase of mechanical stress due to centrifugal force.

2.7. *The Gain-Bandwidth Integral of a Particular Type of Amplifier working to Constant Electrical Stressing is Independent of its Power Rating*

In this section we shall assume that *electrical* stressing sets the limit, and not thermal or mechanical considerations. This condition will usually apply to low-power amplifiers but not to high-power stages: and in practice it is often convenient to treat separately the low-power stages (e.g., 'voltage-amplifying' stages in a thermionic system) and the final stages rated at high power. If the stressing is constant the increase of power rating must be achieved by increasing the size, and it will therefore suffice to study the effect of a uniform increase by a factor x in all linear dimensions. Three types of amplifier will now be examined.

Magnetic Amplifier

The inductance will vary as x and winding resistance as $1/x$ so that the time-constant varies as x^2. But the output power is proportional to E^2/R_L; the supply voltage E, sufficient to produce the saturation flux in the core, is proportional to sectional area of the core and therefore to x^2; and the load resistance R_L is matched to ωL of the transductor and therefore proportional to x. It follows that the output power rating is proportional to x^3, which is expected from first principles since the output power is proportional to the electromagnetic field energy which in turn is fixed jointly by electromagnetic field-strength and volume. To maintain the same magnetic conditions requires the same ratio of ampere turns to length and therefore an x-fold increase in ampere turns: the input power i^2R is thus increased by $x^2/x = x$ times and the power gain by $x^3/x = x^2$ times. But this was also the factor by which the time-constant was increased, so the figure of merit is unchanged.

Rotary Amplifier

By the same arguments that were used for the magnetic amplifier, the L/R time-constant is increased as x^2 and the input power as x. The armature e.m.f. *in a constant field-strength* and at constant angular velocity will be increased as x^2, a double factor which may be regarded as once for length of armature conductor and once for peripheral speed, or as squared for the area enclosed by the armature circuit. If one then assumed a load matched to the armature resistance ($R \propto 1/x$) the output power E^2/R_L would vary as x^5. But this is clearly not consistent with *constancy of field-strength* since the latter requires the resultant of field flux and armature flux to produce a constant flux density. In other words, armature reaction will limit the output current to an x-fold increase for like conditions and the power output $E \times i$ will increase as x^3. The remaining relations are then the same as for the magnetic amplifier, leading to a constant ratio of gain to time-constant[5].

Thermionic Valve

If all dimensions are increased as x and with constant current density, the anode current increases as x^2. Now the current density is proportional to $V^{3/2}/d^2$ where V is the anode voltage and d the anode–cathode distance (both referred to the equivalent diode) so that increase of d by a factor x requires V to be increased by $x^{4/3}$. If the load line is to occupy a similar position in the new field of characteristics, its value must be adjusted in proportion to the change of relative scales of the V and i axes; i.e., R_L must vary as V/i which is as $x^{-2/3}$. The output power may then be expressed either as V^2/R or as i^2R and is proportional to $x^{10/3}$. The ratio of output power to input squared voltage may be based on the current-generator equivalent circuit and expressed as

$$\frac{W_{out}}{V_g{}^2} = g_m{}^2\left(\frac{r_a}{R_L + r_a}\right)^2 R_L \quad .. \quad .. \quad (4)$$

It has already been shown that $R_L \propto x^{-2/3}$ and since the amplification factor μ is a purely geometric factor which will be unchanged by uniform increase in dimensions, g_m must vary as $1/r_a$, which latter can be deduced from the equivalent diode relationship

$$g = \frac{\partial i}{\partial V} = \frac{\partial}{\partial V}\left(\frac{J_0 A V^{3/2}}{d^2}\right) \quad .. \quad .. \quad (5)$$

where A is the cathode area which must be used in order to convert the invariant current density J_0 to a total current. The factors A and d^2 cancel out as far as change of size is concerned, so $g \propto V^{\frac{1}{2}} \propto x^{2/3}$; and the middle factor on the right of (4) depends only on the ratio of R_L to r_a which is assumed invariant, so the dimensional result from (4) is

$$\frac{W_{out}}{V_g{}^2} \propto x^{2/3} \quad .. \quad .. \quad .. \quad .. \quad (6)$$

Now the direct dual of the magnetic input system of an inductance with resistive winding would be an input capacitance with leaky dielectric; and in that case the input resistance would vary inversely as x and hence input power for a given voltage would vary directly as x and the power

gain would vary as $x^{1/3}$ (compare x^2 in the amplifiers having magnetic input systems). On this basis the input time-constant would be independent of x, since $C \propto x$ and $R \propto 1/x$. But this is not in fact the situation, and a more reasonable basis is to assume that (a) the maximum grid-circuit resistance is determined by the ion current, (b) the ion current to the grid is proportional to the anode current, and (c) the tolerable change of grid potential due to ion current is a constant fraction of V_g. From assumptions (a) and (b) it follows that $i_g \propto x^2$ but since $V \propto x^{4/3}$ the grid resistance is determined by

$$R_g \propto \frac{V_g}{i_g} \propto \frac{x^{4/3}}{x^2} = x^{-2/3} \quad .. \quad .. \quad (7)$$

Since the input capacitance is proportional to x, the time-constant is

$$R_g C \propto x^{1/3} \quad .. \quad .. \quad .. \quad .. \quad (8)$$

Strangely enough it was found above that the power gain varies as $x^{1/3}$ so on the present argument the ratio of gain to time-constant is independent of the size of the valve if the current-density is invariant.

It seems doubtful whether this result is more than a happy coincidence, since the supposition that ion current is proportional to anode current ignores both the effect of lengthening the path between cathode and anode, which increases the number of *collisions* to be expected per unit of anode current, and the effect of the higher electron velocity in the larger valve, which changes the probability that a collision or near approach will result in ionization, and the effect of the surface/volume ratio on the relative vacuum in different sizes of valve. A more fundamental approach might be in terms of the input power absorbed by transit-time loading of the input circuit, but this is an infinitesimal factor at low frequencies.

3. Thermal and Mechanical Limitations

The results found in Section 2.7 may be valid for low-power devices, but it will often be found that when substantial power ratings are involved there are thermal or mechanical factors which prevent the larger amplifier from being worked at the same level of electromagnetic stresses as a small one. The large amplifier may then have a lower figure of merit than would be calculated from purely electrical considerations. In order to display the factors involved, the discussion throughout this paper is framed in terms of a uniform geometric change of scale, without change of shape; but the designer may choose to change the shape of the amplifier when increasing the size so as to avoid the anticipated deterioration of gain-bandwidth figure.

For example, in a rotary machine the major increase may go in length (although this is in principle uneconomic in copper) so as to avoid the centrifugal limitation. Obviously there could ultimately be a further mechanical limitation here in terms of whip, and the question is whether one might be better advised to drop the gain-bandwidth figure and use more than one stage. One could either reduce angular velocity in the large machine, or in a given frame size one might increase the air gap so as to allow larger currents in the output circuit before reaching saturation of the iron. Either modification would reduce the gain. In a magnetic amplifier one could increase the core section at the expense of winding resistance to allow for the different-effects of scale factor on copper loss and on iron loss. Adjustments of this sort must usually be made to suit the specific application and are not amenable to general theoretical discussion.

3.1. *Magnetic Amplifiers*

It was found in Section 2.7 that the power rating should increase as the volume, but unless special cooling methods are employed the rate of loss of heat is proportional only to the surface. Since the inductance increases as x and the load resistance should increase similarly to retain equivalent operating conditions, the output current should also increase as x to make $i^2R_L \propto x^3$. But the dissipation in the transductor winding will be i^2R_i and since the winding resistance R_i varies as $1/x$ the copper loss varies only as x. The surface increasing as x^2 is therefore well able to dispose of the additional copper loss. Also the thermal conductance from inside to outside of the coil is proportional to x (i.e., varies in the same way as the heat generated) so the temperature difference between inside and outside of the coil will be independent of x.

This is saying, in effect, that when the core shape is constant the copper loss becomes a decreasing fraction of the power output, which is quite possible since the basis of comparison was essentially equality of magnetic conditions in the iron. The hysteresis loss in the iron will remain a constant figure per unit volume, but the eddy-current loss requires further examination. We have said that the full-load output current should increase as x but so does the length of magnetic path; and so the maximum value of H (e.g., measured in amps/metre) should be independent of x. But the eddy-current density is proportional to H, and therefore the total iron loss, hysteresis plus eddy-current, remains at a constant rate per unit volume and both the mean iron temperature and the temperature difference between the inside and outside of the core will tend to increase with larger cores because the *total* loss increases as x^3.

The author is not aware of any detailed data on core losses in transductors, but it is clear that when large alternating currents are flowing in the windings (due to saturation of the core) the eddy currents must be greater than they would be for the same core used as an unsaturated choke. Some tentative experimental figures* confirm the existence of substantial eddy-current loss under polarized conditions when the core is sufficiently finely laminated to make eddy-current losses negligible when the core is not saturated. The core was of H.C.R. metal strip, 0·002 in. thick, wound to form a toroid of 4 in. and 3 in. outer and inner diameters and $\frac{3}{4}$ in. axial thickness; and the following table refers to an alternating flux cycle of 1 Wb./m^2 peak at four frequencies and in the absence or presence of a small polarizing current. It will be seen that

TABLE

f (c/s)	Loss in ergs/gm/cycle			
	Un-polarized	Polarized	Difference	Diff./ Freq.
75	92·5	147	54·5	0·727
100	91·5	182	90·5	0·905
125	92	186	94	0·752
150	92	195·5	103·5	0·69

loss in the unpolarized core is a constant value per cycle, implying that it is due to hysteresis and not to eddy currents. The additional loss *per cycle* with polarizing current tends to be proportional to f thus making the loss power proportional to the square of frequency as one would expect for eddy currents.

The balance between copper loss and iron loss as a limiting factor will depend on the characteristics of the iron and on working frequency versus lamination thickness so that no generalization is possible.

3.2. *Rotary Amplifiers*

The arguments for copper loss and eddy-current loss are similar to those for transductors, but in rotary machines there is the additional limitation of angular velocity in the larger sizes on account of centrifugal force. At constant angular velocity it was found in Section 2.7 that the output rating was proportional to x^3 and the gain/time-constant ratio independent of x. Constancy of centrifugal stress requires that $r\omega$ be constant (i.e., that if r is increased by x then ω is decreased by x) and the e.m.f. will under this condition increase as x (x^{+2} for area enclosed by armature coil but x^{-1} for angular velocity) with power rating varying as x^2. This means that when centrifugal stress is a limiting factor an increase of size will give rather less than the usual increase of gain and will cause a *decrease* in the gain/time-constant figure.

3.3. *Thermionic Valves*

Apart from current density at the cathode, the major limitation is thermal dissipation at the anode. A linear scaling up of the valve (with constant load-line and operating cycle) increases the dissipation as $x^{10/3}$ (x^2 for increase of current and $x^{4/3}$ for increase of voltage) while increasing the anode surface only as x^2. Thus anode dissipation, rather than cathode emission, is the limiting factor in large valves unless the anode impedance has to be made exceptionally low. The heating of the grid by radiation from the cathode is more or less independent of size, since the cathode power is proportional to current emitted (i.e., to cathode surface) as is the surface of the grid. The removal of the grid to a greater distance from the cathode is not significant unless the grid also subtends a smaller solid angle at the cathode.

In so far as the anode dissipation limits the current density, it will tend to reduce the gain × bandwidth figure; but in thermionic valves there is such wide scope for variation of electrode configurations that one cannot generalize on the relation between size and figure of merit.

4. Multi-Stage Amplifiers

Some reference has already been made (in Section 2.5) to the use of feedback as a means of 'transferring responsibility' from one part of a system to another. This needs some amplification when the complete system consists of a number of stages including more than one type, and there is also the question of the extent to which it is desirable to increase the number of stages of a given type so as to secure greater bandwidth with a given overall gain.

4.1. *Choice of Number of Stages*

The author does not propose to discuss the problem of so-called optimization of amplifier chains, since 'optimization' depends entirely on the criterion chosen. In particular it is probably useful to distinguish between two extreme cases which may be called the 'communication' and the 'servo' cases. In the former, the sole requirement is that the output waveform, whether expressed as a time-function or as a spectrum of sinusoidal components, shall be as nearly as possible identical in form with the input but with some scalar multiplier and an arbitrary time-delay, the magnitude of the latter being (within reason) unimportant. In the servo case,

*These figures are derived from figures of ergs loss/gm/cycle which were measured in Birmingham by Mr. F. Grilo in 1952, using apparatus of the type proposed by Choudbury and Glynne, *Proc. Instn elect. Engrs*, Part II, 1951, Vol. 98, p. 539.

however, it is required that the output should be connected back to the input and that the stable loop gain should be maximized. This means that no absolute delay may be permitted, since it is well known (see, for example, Wiener[6]) that a system with absolute delay has a circular Nyquist locus and is unstable if there is a positive loop gain. The design of servo systems therefore involves special considerations which will not be discussed here. On the other hand *fractional* feedback is often used in 'communication'-type amplifiers for various purposes, and the degree of feedback desired must be considered when establishing the criterion of optimization. There are, however, some general principles which are useful in connection with both types of application.

If each stage could be represented by a scalar amplification factor A and a pure time-delay T (both independent of frequency) then a chain of amplifiers would be characterized by an overall delay equal to the sum of the individual delays and an overall amplification equal to the product of the individual amplification factors (or overall gain equal to the sum of the individual gains in decibels). In this situation the gain-bandwidth product for the whole chain would be maximized by reducing the amplification per stage to a factor of 2 (or 6 db).

This simple representation is still a useful approximation when each stage involves a single exponential time-constant (instead of an absolute delay). If in this application 'overall time-constant' is taken as the time required for the output to rise to half the final output when the input is a step function, it will be found that the overall time-constant is of the order of $(n - \frac{1}{2})T$ where n is the number of stages and T the time-constant of each stage.

It should also be noted that adjustment of the frequency characteristic so as to compress the whole of the gain-bandwidth of an amplifier into a constant gain over a specified band will give it the characteristic of a low-pass or band-pass filter. The minimum phase characteristic associated with such a frequency response tends to a constant slope over the pass-band; i.e., a flat-pass-band amplifier contributes a constant delay to all signals which it transmits. The original idea of adding time-constants therefore has a very definite meaning in this case where both bandwidth and time-constant are clearly definable entities.

On a particular criterion of optimization which has been proposed by Tustin[7] for servo systems, Layton[8] has shown that the optimum number of equal stages is such that amplification per stage is e times, which is not of different order from the value of 2 per stage which follows from the argument of adding time-constants. It has also been stated by Percival[9] that when a number of stages of distributed amplification (see Section 4.4) are cascaded, the most economic design is that in which the amplification per stage is e times.

4.2. *Effect of Feedback on Individual Power Ratings in a Mixed System*

The most obvious example of a 'mixed system' is the common type of electrical servo system in which thermionic valves are used in the low-power stages and rotating machines as high-power amplifiers, and perhaps the combination of thermionic valves with magnetic amplifiers is almost identical: in both these cases the gain-bandwidth figure for the thermionic amplifiers is virtually infinite compared with that of the other stages based on magnetic energy. But there are in fact intermediate cases, as in an all-thermionic amplifier where for various reasons the characteristics of the output stage are less favourable than those of earlier stages. On a simple 'linear' theory, in which the characteristics of the stages were assumed independent of amplitude of signal, it would appear that almost any desired overall characteristic could be obtained by applying sufficient feedback to transfer the control of the characteristics to the wide-band stages, if necessary increasing the number of wide-band stages in order to obtain sufficient loop gain.

But one limit is clearly that no narrow-band stage can be worked at a frequency beyond that for which its gain (possibly after optimizing the gain/frequency characteristic with reactive networks or local feedback) falls to zero db. This is, of course, well known in high-frequency technique, where the *gain* of an amplifier is often expressed in *megacycles*, the latter standing for the bandwidth over which zero db transmission can be obtained, and it is immediately recognized that an amplifier is useless for bandwidths greater than this figure. A way out of this limit in high-frequency systems is provided by 'distributed amplifiers', the role of which will be discussed separately, but where these cannot be used there is no option but to push up the performance of the individual amplifier (by higher stressing or by improved design or materials) until the gain-bandwidth is sufficient to meet the duty specification.

Two simple examples will illustrate the way in which feedback throws an extra load on the wideband stages. If a pentode valve is used to drive a capacitive load (e.g., a high-speed c.r. oscilloscope) the output voltage will fall at high frequencies but on linear theory could be restored by applying positive feedback via a top-boost circuit, otherwise known as 'positive-derivative

feedback'. But this clearly cannot increase the current swing which the valve is capable of handling, and on positive signals grid-current limitation will be found to make the frequency correction impossible.

Similarly if a pentode is used to feed an inductive load (e.g., the field coil of a machine) the current through the coil will decrease at high frequencies and any attempt at correction by feedback will come up against the limit $di/dt = E/L$, where di/dt is the rate of rise of current, E the *supply* voltage and L the load inductance. In either case an isolated negative-going signal can be handled subject only to the peak current or voltage rating of the valve anode, but even then the after-effects of the negative peak may cause difficulty if other signals follow. It should be noted that of the two examples given one meets a power limitation in the input circuit and the other in the output circuit.

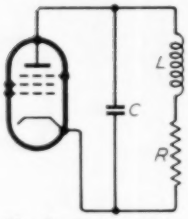

Fig. 6. *Inductively-compensated inter-valve coupling.*

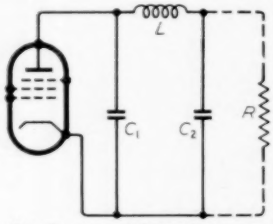

Fig. 7. *Non-dissipative coupling.*

Since energy storage is not practicable unless the signals are periodic, an amplifier must in general have a *power* rating equal to the maximum *volt-amp* output which may be demanded from it in service, and the approximate power ratings of a chain of amplifiers can be calculated accordingly. In the high-speed c.r. oscilloscope example, specification of the writing speed in metres per microsecond dictates that a certain electrostatic energy $\frac{1}{2}CV^2$ shall be fed to the deflecting plates per microsecond, and this translated into a volt-amp figure sets the power rating of the output valve. This rating is independent of the circuitry which may be used to drive the valve, and the top working frequency is set by the bandwidth at which available valves will give gain. Similarly, in a position-control system, the inertia and required acceleration of the load determine the power rating of the driving motor and the last amplifier stage; knowing the gain of the last stage one then knows the necessary power rating of the preceding stage, and so on.

4.3. *Reactive Networks and Non-Periodic Signals*

It was remarked in the preceding section that energy storage cannot be used to reduce the output volt-amp demand on the amplifier unless the signals are periodic, and it is therefore necessary to re-examine the role of reactive networks.

Consider first the two-terminal 'inductively compensated' valve anode circuit of Fig. 6, where the capacitance C represents the load (e.g., the c.r.o. deflector plates). It is clear that *no value of L can make more current flow into C than would flow if the L,R branch were completely absent.*

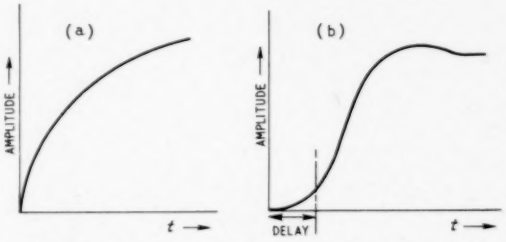

Fig. 8. *Time response of uncorrected (a) and corrected (b) circuits.*

The overall performance at all frequencies must therefore be less than that indicated by the 'parasitic' reactance. The presence of R is necessary to feed power to the valve, but its dissipative nature reduces the available gain-bandwidth to an extent which is only moderated by the addition of L. Next take the non-dissipative coupling network of Fig. 7, where C_1 is the output capacitance of the valve and C_2 the capacitance of the load. (If a good 'frequency response' is desired, dissipation will in fact have to be added in the form of the filter-terminating resistance R. It is assumed that d.c. is fed to the valve anode via a large choke, or else via R and L.) It is evident that if an isolated step signal is fed in, the presence of L cannot increase the total current which is available to charge C_1 and C_2. What it does do is to delay the charging of C_2 until some energy has been accumulated in C_1 and then use this via the storage properties of L to ensure that C_2 eventually charges rapidly to competion instead of following an exponential law. In terms of the frequency description, the phase characteristic has been equalized so that the phase-shift is linearly proportional to frequency. But in terms of the time-function description the start of the rise has been *delayed* so as to obtain a steeper rise, as sketched in Fig. 8. This follows from the phase and delay characteristics of a CR circuit and an idealized low-pass filter which are sketched in Fig. 9. (Delay $= d\phi/d\omega$.)

It follows that in servo systems, where *delay* causes *instability*, the performance cannot be improved by adding correcting networks or

frequency-selective feedback to individual stages.* In terms of feedback-amplifier design, this is more usually expressed in the form that the rate of cut-off must be limited in order to secure stability: shaping the responses of the individual circuits towards a rectangular pass-band would give rise to an intolerably steep cut-off.

It then appears that in addition to the choice of the most economic average stage gain for a given type of amplifier it may be necessary to stagger the bandwidths (and hence the gains) of the various stages in the particular case of a servo system or an amplifier with very heavy feedback, but the design of such systems for stability is a separate topic. They have been mentioned in this paper only to emphasize that frequency- and phase-equalization is valid only if a uniform delay of the signal is unimportant.

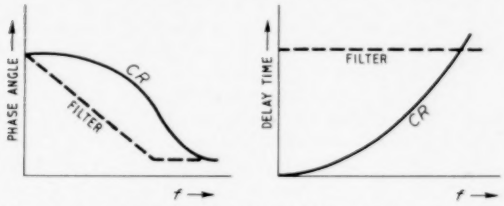

Fig. 9. *Phase (a) and delay (b) characteristics of an RC circuit and of an ideal filter.*

4.4. *Distributed Amplifiers*

In connection with the filter type of interstage couplings in Figs. 5 and 7 it has been pointed out that dissipation will be required when non-periodic signals are involved: the energy in the input side of an amplifier must be removed at the completion of the unit of signal which it represents, and the energy cannot be stored unless it is certain to be required again when the signal is repeated, so for non-periodic signals the energy must be dissipated *so far as the individual amplifying device is concerned.* The feature of the distributed amplifier is that instead of being immediately dissipated the energy is transferred to another similar amplifying device, then to a third, and so on. The several outputs are subjected to delays identical with their input delays and then summed. With thermionic valves as the individual amplifying devices this is regarded as equivalent to paralleling the mutual conductances of all the valves while leaving the effective input and output capacitances equal to those of a single stage, so that by adding sufficient valves the bandwidth (which is basically proportional to g_m/C) can be increased without limit. But the addition of each further valve adds the delay of a section of the filter structure to the overall response. It follows that although the gain-bandwidth integral (measured on periodic signals) is improved, *the gain/time-constant ratio of the distributed amplifier is no better than that of a single valve.* The gain/time-constant ratio is thus shown to be the more fundamental parameter, the weakness of the gain-bandwidth parameter being that it ignores phase: in the time plane a single $f(t)$ suffices to define a waveform over any interval of time, but in the frequency plane both frequency and phase functions must be given to specify a waveform.

In view of their delay characteristics distributed amplifiers do not appear useful as cascaded constituents of multi-stage amplifying systems when heavy overall feedback is required. But there appears to be no reason why extreme feedback should not be applied across each unit within the distributed amplifier; e.g., by making a 'distributed cathode follower' which would give very nearly 1:1 ratio of output to input *amplitudes* but at different power levels. This would be practicable for communication systems but would fail for most electro-mechanical servo systems (i.e., all servo systems other than those of zero order) because in the latter the feedback loop is required to include one or more 'integrations' (e.g., two integrations to transform torque to position) and the maintenance of equality of input and output of the purely electrical system is not the appropriate criterion.

*This does not exclude the use of various forms of feedback to transfer control of the characteristic from one circuit to another, subject to the power-rating considerations discussed in Section 4.2.

Acknowledgments

The author's thoughts on this topic have been greatly stimulated by discussion with other members of the Department of Electrical Engineering, University of Birmingham and, in particular, he wishes to record his thanks to those whose contributions have been cited in the paper.

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ANALOGUES OF AN IONIZED MEDIUM

Applications to the Ionosphere

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Introduction

TO an engineer trained in the theory of electrical circuits it is often enlightening to know that a physical system has an equivalent circuit; i.e., that a circuit exists whose behaviour is governed by similar equations. His familiarity with circuits often means that the equivalent circuit gives him a deeper insight into the system than he gains at first sight from its equations or other sufficient specification.

The present paper shows that circuits, well known in the theory of transmission lines, are associated with equations of the same form as those governing the propagation of plane electromagnetic waves in ionized media. They are considered with special reference to the ionosphere. It is hoped that the interesting circuits obtained will clarify some of the essential features of ionospheric propagation for those who are not well versed in the theory of ionized media, and also be a stimulus to those engaged in teaching and research.

When the analogy has been grasped, statements about the ionized medium may be reduced to statements about a transmission line, and known properties of the line may be translated in terms of the ionized medium. The well-known transmission-line formulae may be summarized briefly here, for convenience in comparing them with formulae for the ionized medium.

A transmission line is specified, for an angular frequency ω, by its series impedance $R + jX$ and shunt admittance $G + jB$, each measured per unit length of line. Alternatively, we may use the characteristic impedance Z_0 and propagation constant Γ, defined as

$$Z_0 = \sqrt{\frac{R + jX}{G + jB}},$$

$$\Gamma = \sqrt{(R + jX)(G + jB)}.$$

The attenuation constant α (nepers per unit length) and the phase constant β (radians per unit length) are respectively the real and imaginary parts of the propagation constant Γ:

$$\Gamma = \alpha + j\beta.$$

The wavelength on the transmission line λ' and the phase velocity u_p are obtained from the phase constant β as follows:

$$\lambda' = \frac{2\pi}{\beta}; \quad u_p = \frac{\omega}{\beta}$$

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and the group velocity is given by $u_g = \delta\omega/\delta\beta$.

The differential equations for the potential difference $V(x)\, e^{j\omega t}$ between the conductors of the line and the current $I(x)\, e^{j\omega t}$ in the conductors are

$$\frac{\delta V}{\delta x} = -(R + jX)I$$

and

$$-\frac{\delta I}{\delta x} = (G + jB)V$$

where x is distance measured along the line. The first of these states that the change in V per unit length of line is equal to the potential drop produced by the line current I flowing in the series impedance of the unit length. The second states that the drop in I equals the current which is diverted through the shunt admittance.

A conventional representation of the continuous transmission line is given in Fig. 1, which shows a four-terminal network with lumped elements, equivalent to an infinitesimal segment dx of the line. This figure, and similar ones following, from which dx is omitted, are intended simply as diagrammatic statements of the parameters of the line. But we may, if we wish, conveniently think of the transmission line as a series of these networks in cascade because the behaviour would be the same as for a continuous line if the sections were kept short in comparison with the wavelength. The sign conventions are also laid down by Fig. 1.

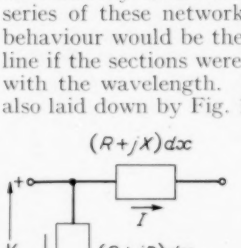

Fig. 1 (left). *A conventional representation of a continuous transmission line with series impedance $R + jX$ and shunt admittance $G + jB$ per unit length.*

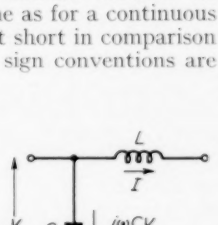

Fig. 2 (right). *The transmission-line analogue for linearly-polarized plane waves in free space.*

Equivalent Circuit for Free Space

As a basis for the work, we seek a circuit analogue for linearly-polarized plane electromagnetic waves in a medium which is not ionized, say free space. The procedure is to set up the equations governing the dependence of the electric and magnetic fields E and H on the coordinate x and on time t, and to think up a

circuit which obeys similar equations. Corresponding variables and coefficients can then be compiled into a table of analogous quantities, and this table may be used to translate propositions from the language of one system to that of the other.

In the present simple case, the Maxwell equations

$$\text{curl } \mathcal{E} = -\mu_0 \frac{\partial H}{\partial t}$$

and

$$\text{curl } H = \epsilon_0 \frac{\partial E}{\partial t}$$

become, for harmonic fields, dependent on one spatial co-ordinate,

$$\frac{\partial E}{\partial x} = -j\omega\mu_0 H \quad .. \quad .. \quad .. \quad (1)$$

and

$$-\frac{\partial H}{\partial x} = j\omega\epsilon_0 E. \quad .. \quad .. \quad .. \quad (2)$$

The voltage and current equations for a transmission line in which the series impedance per unit length is that of an inductance L, and the shunt admittance per unit length is that of a capacitance C, are

$$\frac{\partial V}{\partial x} = -j\omega L I \quad .. \quad .. \quad .. \quad (3)$$

and

$$-\frac{\partial I}{\partial x} = j\omega C V. \quad .. \quad .. \quad .. \quad (4)$$

These equations are identical in form with (1) and (2) and comparison yields the analogous quantities shown in Table 1.

TABLE 1

Free space	Circuit
E	V
H	I
ϵ_0	C
μ_0	L

The analogue is thus established. We see that free space behaves as a transmission line with an inductance per unit length μ_0 and a capacitance per unit length ϵ_0. The voltage and current on the transmission line are respectively analogous to the electric and magnetic fields of the wave in free space*

In Fig. 2 we summarize the details of the transmission-line analogue. We may now write down any property of the circuit, and after translating by means of Table 1, we shall have a property of the medium. Now it is shorter in practice to write the symbols for the medium directly on the circuit analogue, as in Fig. 3, thus doing away with the table and the symbols L, C, etc. At the same time we may also introduce a convenient terminology and speak directly of a line current H flowing in a series inductance μ_0 across which the potential change is $-j\omega\mu_0 H$, and so on.

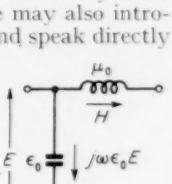

Fig. 3. *A convenient way of recording the transmission-line analogue by combining Fig. 2 and Table 1.*

This close correspondence between the transmission line and free space is well known. Further examples of corresponding quantities are noted in Table 2.

TABLE 2

Free Space		Circuit	
Intrinsic impedance	$\zeta_0 = \sqrt{\frac{\mu_0}{\epsilon_0}}$	characteristic impedance	$Z_0 = \sqrt{\frac{L}{C}}$
Velocity	$c = \frac{1}{\sqrt{\mu_0\epsilon_0}}$		$u_p = \frac{1}{\sqrt{LC}}$
Displacement current density	$j\omega\epsilon_0 E$	capacitor current	$j\omega CV$
Magnetic energy density	$\frac{1}{2}\mu_0 H^2$	stored energy of coil	$\frac{1}{2}LI^2$
Transmitted power	$\frac{E^2}{2\zeta_0}$		$\frac{V^2}{2Z_0}$

Equivalent Circuit for an Ionized Medium

Having dealt with the non-ionized medium, we now consider the field equations for a medium containing free electrons, with a view to finding an appropriate modification to the equivalent circuit. It is assumed that there are as many positive ions as electrons, so that the medium is neutral as a whole, but that the motion of the positive ions may be neglected on account of their great inertia in comparison with electrons.

The effect of the presence of electrons is this. The mechanical force $-eE$ on each electron, due to the electric field E, causes them to move in the medium. This motion represents a convection current J which must be added to the displacement current $j\omega\epsilon_0 E$ in equation (2). Now the velocity of an electron subject to a harmonic force $-eE$ of angular frequency ω is given by

$$u = \frac{-eE}{j\omega m}.$$

(In dynamical analogies[1], where force and

* An alternative analogue exists in which V is interchanged with I and L with C, and consists of the inverse network of the first. It sometimes proves to have advantages (see p. 326).

velocity are taken to correspond respectively with V and I, $j\omega m$ is known as the mechanical impedance of the mass m.) The total convection current density is given by

$$J = Nev,$$

where N is the number of electrons per unit volume.

Consequently the desired equations for the ionized medium are

$$\frac{\delta E}{\delta x} = -j\omega\mu_0 H \quad .. \quad .. \quad .. \quad (5)$$

$$-\frac{\delta H}{\delta x} = j\omega\epsilon_0 E + \frac{Ne^2 E}{j\omega m} \quad .. \quad .. \quad .. \quad (6)$$

Comparison of equation (6) with (4) shows that the new equivalent transmission line must be such that the shunt admittance per unit length is $j\omega\epsilon_0 + (Ne^2/j\omega m)$ instead of $j\omega\epsilon_0$; i.e., the capacitance ϵ_0 must be in parallel with an inductance m/Ne^2. The equations for the equivalent transmission line are thus

$$\frac{\delta V}{\delta x} = -j\omega L I \quad .. \quad .. \quad .. \quad (7)$$

$$-\frac{\delta I}{\delta x} = (j\omega C + \frac{1}{j\omega L_p})\, V \quad .. \quad .. \quad (8)$$

where $L_p = m/Ne^2$. Fig. 4 shows the equivalent transmission line.

This is the important result of this paper*. To describe all the properties of plane waves in a collision-free ionized medium [i.e., all the phenomena implied by equations (5) and (6)], the transmission line of Fig. 4 will be found of sufficient (and necessary) complexity.

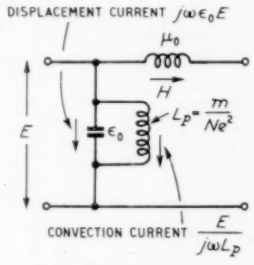

Fig. 4. *The transmission line which is analogous to the ionized medium.*

It is now instructive to consolidate the result by examining equations (5) and (6) again, keeping in mind Fig. 4. Equation (5) simply states that the rate of change (per unit length) of the line 'potential difference' E is that due to the drop in the series inductance μ_0. Equation (6) states that the change in the line current H, between one infinitesimal section and the next, is equal to the current shunted through the capacitance ϵ_0 (as displacement current) and through the inductance L_p (as convection current).

We see that, because of the presence of electrons, the potential difference E drives a shunt current $E/j\omega L_p$ in addition to that for an ordinary medium, $j\omega\epsilon_0 E$. As the convection current is in antiphase with the displacement current, the total shunt current

$$\left(j\omega\epsilon_0 + \frac{1}{j\omega L_p}\right) E = j\omega\left(\epsilon_0 - \frac{1}{\omega^2 L_p}\right) E$$

is less than that for free space; i.e., the ionized medium acts as if its permittivity were reduced to $\epsilon_0 - (\omega^2 L_p)^{-1}$. We thus arrive at the familiar result that the dielectric constant of an ionized medium is

$$1 - \frac{Ne^2}{\epsilon_0\omega^2 m}, \quad .. \quad .. \quad .. \quad (8a)$$

and that a capacitor across which a high inductance is connected in parallel is equivalent to a capacitor of lower capacitance. This is true in a sense and is useful to remember. It leads to the simplified analogue of Fig. 5, where the shunt inductance and capacitance of Fig. 4 are taken to act together as a single frequency-dependent capacitance per unit length of $\epsilon_0 - (\omega^2 L_p)^{-1}$.

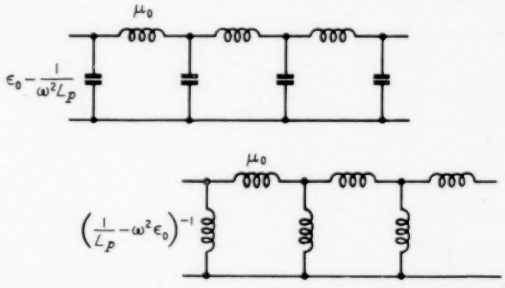

Fig. 5 (above). *A simplification of Fig. 4, obtained by merging the shunt elements as one frequency-dependent capacitance—useful for $\omega > \omega_0$.*

Fig. 6 (right). *An alternative simplification of Fig. 4, appropriate when $\omega < \omega_0$.*

Certain results for the propagation in an ionized medium may now be immediately deduced. The intrinsic impedance of the medium (E/H for a travelling plane wave) is given by the characteristic impedance of the transmission line, viz.*

$$\zeta = \sqrt{\frac{\mu_0}{\epsilon_0 - \frac{1}{\omega^2 L_p}}} \quad .. \quad .. \quad .. \quad (9)$$

The line propagates travelling waves without attenuation with a phase velocity

$$u_p = \frac{1}{\sqrt{\mu_0\left(\epsilon_0 - \frac{1}{\omega^2 L_p}\right)}} \quad .. \quad .. \quad (10)$$

Returning to Fig. 4 to look for special properties, we may note that if more current flows through the shunt inductance than through the shunt capacitance, then the shunt combination will be inductive. The line of Fig. 6 is the result.

* The author is indebted to Dr. D. F. Martyn for pointing out that the result was known to Baker and Rice[3] as early as 1926.

* The intrinsic impedance of free space $\zeta_0 = (\mu_0/\epsilon_0)^{1/2}$ is 377 ohms in m.k.s. units.

Such a line is not capable of propagating travelling waves at all in the steady state. An applied sinusoidal e.m.f. sets up a standing wave whose amplitude decays exponentially with distance. Translating this property of the transmission line in terms of an ionized medium, we conclude that under certain circumstances it may not be possible to transmit through an ionized medium. This is well known as the 'overdense' condition of the medium.

Here we have a case where the initial equations (5) and (6) for a physical system do not, at a quick glance, give as good an idea of the system as does the equivalent circuit of Fig. 4.

Now the condition that the line should behave as in Fig. 6 was that $(\omega L_p)^{-1}$ should be greater than $\omega\epsilon_0$. This condition may be written $\omega < \omega_0$, where ω_0 is given by $(\omega_0 L_p)^{-1} = \omega_0\epsilon_0$, whence

$$\omega_0^2 = \frac{Ne^2}{m\epsilon_0} . \quad .. \quad .. \quad .. \quad (11)$$

This is the usual formula for the critical frequency of an ionized medium.

To see what is happening in the medium, consider a succession of ionized media of increasing ionization density N. Each electron adds a parallel inductance m/e^2, as in Fig. 7, each conveying its contribution to the total shunt current. If sufficient electrons are added the convected current will equal the displacement current so that the potential difference E drives no total shunt current. This condition is described as the permittivity of the medium having fallen to zero, although it will be seen that the state of

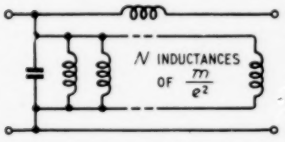

Fig. 7. *Each electron is equivalent to an inductance m/e^2.*

affairs is more truly analogous to the condition of infinite impedance presented by a parallel tuned circuit, than with that presented by zero capacitance. The critical electron density N_c at which this happens follows from the previous equation:

$$N_c = \frac{m\epsilon_0\omega^2}{e^2} \quad .. \quad .. \quad .. \quad (12)$$

or in numerical terms, $N_c = 1{\cdot}24 \times 10^4 f^2$ electrons per cm^3, where f is frequency in Mc/s. When the electron density is very great, the displacement current through ϵ_0 may be neglected and the shunt element is an inductance m/Ne^2. This is well into the overdense condition of the ionized medium and is often described as a state of negative permittivity. Though useful to remember when substituting in certain formulae, the idea of negative permittivity gives a misleading physical picture and should be treated with the same caution as would be accorded to the proposition that an inductance L is a negative capacitance $-1/L\omega^2$. The inductance representing the electrons is not dependent on frequency. If it is treated as a negative capacitance a wholly artificial dependence of the negative capacitance on frequency has to be accepted. It is clear from the present work that an overdense medium really does not have a permittivity. It has shunt permeability.

Effect of Collisions

When collisions occur, with a frequency ν, between an electron and the positive ions or neutral molecules, the effect is to introduce an average force $-mu\nu$ on the electron; i.e., there is a mechanical impedance $m\nu$ to its motion. Without collisions, the impedance of the electron was purely inertial, $j\omega m$. With collisions, it becomes $m\nu + j\omega m$. The electron velocity, in terms of the applied alternating electric force, is given by

$$u = \frac{-eE}{m\nu + j\omega m} . \quad .. \quad .. \quad (13)$$

Equation (6) becomes

$$-\frac{\delta H}{\delta x} = j\omega\epsilon_0 E + \frac{Ne^2 E}{m\nu + j\omega m} . \quad .. \quad (14)$$

Equation (8) becomes

$$-\frac{\delta I}{\delta x} = \left(j\omega C + \frac{1}{R + j\omega L_p}\right) V \; .. \quad (15)$$

where R represents $m\nu/Ne^2$. A circuit giving this equation has now to be found. This equation would result if the current I in the coil L also ran through a resistance R in series with L. Hence the equivalent circuit which takes collisions into account is that of Fig. 8.

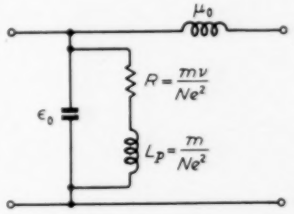

Fig. 8. *Equivalent circuit for ionized medium with collisions.*

All the various formulae for the medium with collisions can be deduced from this circuit. As an example, we revert to the description of the medium in terms of an effective permittivity ϵ, although now a conductivity σ must be allowed for also. Equating $\sigma + j\omega\epsilon$ to the total shunt admittance of the shunt combination in Fig. 8,

$$\sigma + j\omega\epsilon = \frac{1}{R + j\omega L_p} + j\omega\epsilon_0$$

$$= \frac{R}{R^2 + \omega^2 L_p^2} + j\omega\left(\epsilon_0 - \frac{L_p}{R^2 + \omega^2 L_p^2}\right). \quad (16)$$

Hence we have the well-known formulae for the permittivity and conductivity of an ionized medium with collisions:

$$\epsilon = \epsilon_0 - \frac{Ne^2}{m(\omega^2 + \nu^2)} \quad \ldots \quad \ldots \quad (17)$$

$$\sigma = \frac{Ne^2\nu}{m(\nu^2 + \omega^2)} \quad \ldots \quad \ldots \quad (18)$$

As a further example of the use of the circuit we may consider the attenuation constant α of an ionized medium in which the attenuation is small ($\nu \ll \omega$). If in Fig. 8 the potential difference across the line is E, then the flow of power in a travelling wave on the line would be approximately $E^2/2\zeta$, where ζ is obtained, neglecting exponentially. The power attenuation constant 2α is equal to the constant of proportionality, hence

$$\alpha = \tfrac{1}{2}\frac{R}{R^2 + \omega^2 L_p{}^2}\,\zeta = \tfrac{1}{2}\sigma\zeta. \quad (19)$$

In the derivation of this first-order approximation it has been assumed that ζ is real; i.e., we have taken $R \ll \omega L_p$ or $\nu \ll \omega$. The general formula for α is complicated, e.g., it may be quoted in the form

$$\alpha = \frac{\sqrt{2}\pi}{\lambda}\sqrt{\left\{\sqrt{\frac{(\omega^2 - \omega_0{}^2)^2 + \omega^2\nu^2}{\omega^2(\omega^2 + \nu^2)}} - \frac{\omega^2 - \omega_0{}^2 + \nu^2}{\omega^2 + \nu^2}\right\}}. \quad \ldots \quad \ldots \quad (20)$$

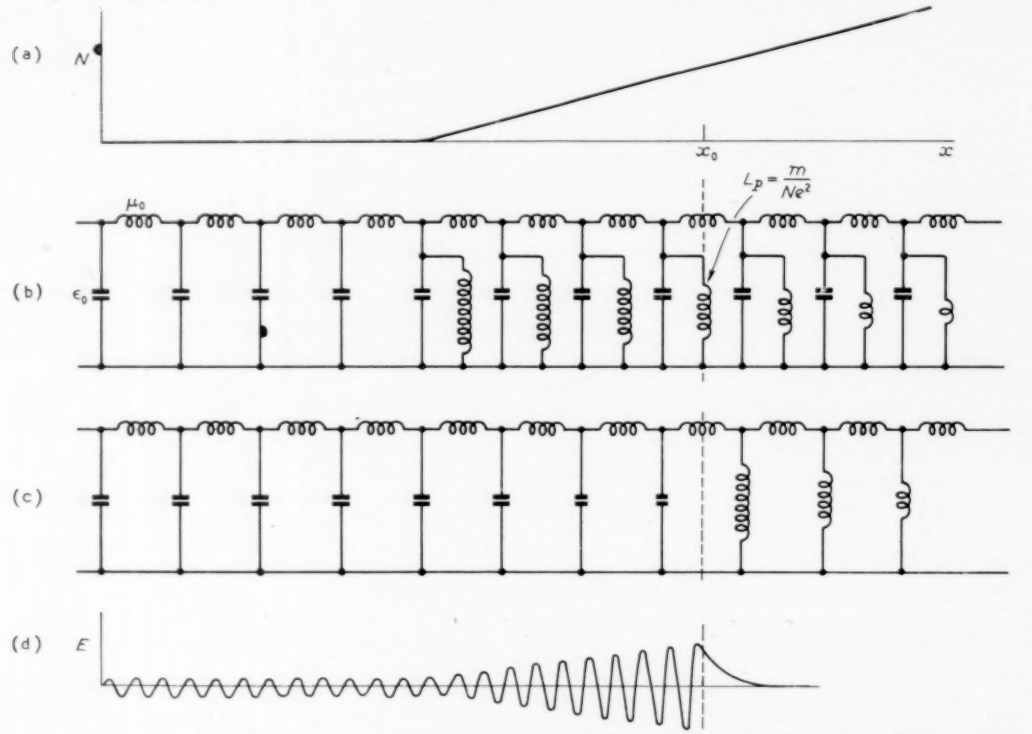

Fig. 9. (*a*) *Electron density distribution with height x.* (*b*) *Equivalent transmission line.* (*c*) *Simplified line for an assigned frequency.* (*d*) *Variation of E and H with height.*

collisions, from the equation given above. Some of this power is dissipated in the resistance R, the amount being $\frac{1}{2}RI_p^2$ where I_p is the current through R. Now

$$\tfrac{1}{2}RI_p^2 = \tfrac{1}{2}R\frac{E^2}{R^2 + \omega^2 L_p{}^2}.$$

The expression for dissipation and power flow confirm that the one is proportional to the other, and that therefore, the power flow decays

At this point experience with transmission lines allows us to import more practical expressions of the formula, which possibly are not known in the literature of ionized media. We introduce the useful concept of the Q of a medium, which is defined as the Q of a capacitor or perfectly conducting cavity resonator containing that medium as dielectric, i.e.

$$Q = \frac{\omega\epsilon}{\sigma}. \quad \ldots \quad \ldots \quad \ldots \quad (21)$$

The following expansion for α (See Schelkunoff, 'Electromagnetic Waves', p. 85) may now be interpreted in terms of the ionized medium:

$$\alpha = \tfrac{1}{2}\sigma\zeta\left(1 - \frac{1}{8Q^2} + \frac{7}{128Q^4} - \dots\right) \quad .. \quad (22)$$

It will be seen that the first term gives the approximation derived above, and that correction terms where necessary may readily be applied.

Equivalent Circuit of the Ionosphere

In this section and the next we deal with cases of inhomogeneous media. Consider a plane wave incident vertically on the ionosphere and let the ionization density N depend on the height x as in Fig. 9(a). Fig. 9(b) gives the equivalent circuit: all the series elements are inductances μ_0, all the shunt capacitances ϵ_0, and the shunt inductances are in inverse proportion to N, and decrease from left to right. This circuit is the same for all frequencies. If the frequency is now assigned we can mark the height $x = x_0$ where N becomes large enough to make the medium overdense. An instructive equivalent circuit (for the given frequency only) is shown in Fig. 9(c), where the effective shunt capacitance diminishes with height up to the height x_0, beyond which the shunt elements are diminishing inductances. Below x_0 we have a 'tapered' line whose characteristic impedance and phase velocity increase with height. Above x_0 we have an inductive ladder network of increasing attenuation.

If we suppose that the medium varies its properties only a little in one wavelength, then a wave incident from the left adapts itself to the increasing characteristic impedance by raising its ratio of E to H. E exceeds and H falls below its free space value in such a way as to maintain the power flow EH constant. At the same time, the wavelength increases. Since there can be no steady propagation of energy beyond x_0, complete reflection occurs and a standing wave is set up [Fig. 9(d)]. Above x_0, the field dies away as an evanescent wave.

An Application

It is known that a layer of electrons, thin compared with the wavelength, can produce strong reflection. However, even though the medium within the layer may be overdense, there is no total reflection short of infinite electron density. Some energy always leaks through a thin layer. A curious but well-known further property is the ability of a highly-reflecting screen to transmit incident waves if the medium beyond the screen satisfies certain conditions of resonance. These properties become quite clear in terms of the transmission line.

Let unit area of a thin layer contain n electrons. Then the equivalent transmission line has a lumped inductance $\mathscr{L} = \dfrac{m}{ne^2}$ in parallel at the point corresponding to the position of the layer. The reflection coefficient is

$$\frac{\sigma + \dfrac{1}{j\omega L}}{2Y_0 + \dfrac{1}{j\omega L}} \quad \text{from the expression} \quad \frac{Y_L - Y_0}{Y_L + Y_0}$$

However small the inductance, there is still some transmission.

Now in transmission-line practice, the reflection from $\mathscr{L}$ could be cancelled by further reflection from a point farther along the line; i.e., it is possible by proper matching to get the incident energy to pass the barrier.

One method of matching would be to place a further inductance across the line. It follows that two thin parallel layers of ionization, each strongly reflecting in itself, could in conjunction, be penetrable.

In addition to the transmission-line analogue, which has now been outlined, totally different analogues of the ionized medium exist and may sometimes be useful. For example, there is a realizable mechanical analogue which could be used for demonstration purposes, and a waveguide analogue which should not be overlooked.

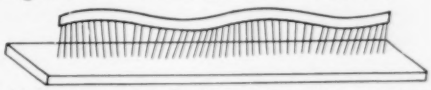

Fig 10. *A massive flexible spring strip supported on closely-spaced flexible wires is a strict analogue of an ionized medium. The greater the ionization density, the greater the stiffness of the wires.*

A Mechanical Analogue

Consider a flexible spring strip with mass per unit length M and compliance per unit length K. Transverse waves on the strip are described by the equations

$$\frac{\delta u}{\delta x} = -j\omega K f$$
$$-\frac{\delta f}{\delta x} = j\omega M u \quad .. \quad .. \quad .. \quad (23)$$

where u is the transverse velocity and f the mechanical force. Comparison with equations (1) and (2) shows that there is a strict analogy as follows:

Free space	Spring strip
E	u
H	f
ϵ_0	M
μ_0	K

If now the transverse motion is subject to a spring force additional to that due to bending of the strip itself, the system becomes analogous to an ionized medium. A means of doing this with flexible wires of negligible mass is illustrated in Fig. 10. In another feasible realization, the strip would be suspended from light, perfectly flexible threads.

Equation (23) becomes

$$-\frac{\delta f}{\delta x} = j\omega M u + \frac{u}{j\omega K_p} \quad \ldots \quad \ldots \quad (24)$$

and K_p, the compliance per unit length of the additional springs, is analogous to m/Ne^2.

The critical frequency of the medium is the frequency at which each flexible wire would resonate if severed by cuts in the spring strip half-way to the adjacent needles. The overdense condition corresponds to oscillation of the strip when the inertial force on the strip due to its own mass is not as great as that due to the flexible wire.

In acoustical and dynamical analogues it is common to take E and H analogous to f and u respectively. We adopt the other alternative here because it leads to the simpler mechanical arrangement.

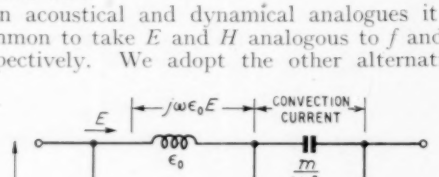

Fig. 11 (above). *The inverse network of Fig. 8 is also an analogue of the ionized medium.*

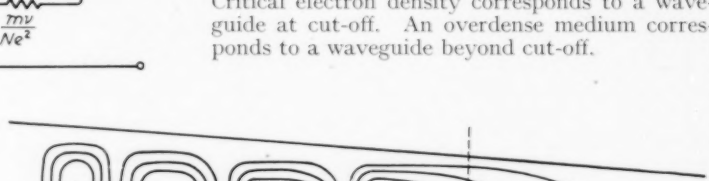

Fig. 12 (right). *Magnetic field lines in a tapered rectangular waveguide showing the reflection of a wave incident from the left.*

If now our mechanical system is translated back into an electric circuit by the conventional analogy, we obtain the inverse circuit mentioned earlier, and which is shown in Fig. 11. Free space corresponds to a series inductance ϵ_0 and a shunt capacitance μ_0. The presence of N electrons per unit volume introduces N series capacitances m/e^2 in series with ϵ_0. The potential differences across ϵ_0 and the capacitance m/Ne^2 represent the displacement and convection currents. For completeness, the resistance $m\nu/Ne^2$, which represents the effect of collisions, has been added.

A Waveguide Analogue

A partial analogy exists between a plane wave in an ionized medium and a wave in a waveguide; partial because the number of space co-ordinates is one in the first case and two in the second. The limitations of this analogy will not be discussed but the result will be given for the light it throws on ionospheric propagation.

Consider a rectangular waveguide of width a operating in the usual H_{01} mode. The propagation constant is

$$j\omega\sqrt{\epsilon_0\mu_0}\sqrt{1-\frac{\omega_0^2}{\omega^2}}$$

where ω_0 is the cut-off frequency. This expression is identical with that for the ionized medium with no collisions. Diminution of the waveguide width a has the same effect on propagation (phase velocity, group velocity, wavelength) as increase in electron density N, and the numerical correspondence is exact if the relation between a and N is

$$a = \frac{\pi}{e}\sqrt{\frac{m}{\mu_0 N}} .$$

Critical electron density corresponds to a waveguide at cut-off. An overdense medium corresponds to a waveguide beyond cut-off.

The situation of Fig. 9, in which the electron density increases with height, is represented by a waveguide (Fig. 12) tapered through the critical width, and shows how reflection occurs in a way resembling that shown in Fig. 9.

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[2] W. G. Baker and C. W. Rice, "Refraction of Short Radio Waves in the Upper Atmosphere", *Trans. Amer. Inst. Elect. Engrs*, 1926, Vol. 45, pp. 302-333.

DESIGN OF VIDEO COUPLINGS

Use of Complex Zeros and Poles

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SUMMARY.—The paper presents a method of designing low rise-time video amplifier coupling networks with three (or four) independent elements by the proper location of complex zeros and poles of the network function. The relationships subsisting between the different transient response characteristics (e.g., rise-time, overshoot and time delay) are found. Graphs are presented in such a way that the type of response of a circuit with given constants, and also the constants of the circuit for a given type of response, can be directly determined.

1. Introduction

IN a large number of electronic applications, amplifiers are required to handle signal waveforms with discontinuous derivatives. They never provide faithful reproduction, however, due to the presence of unavoidable interelectrode capacitances. By the proper adjustment of the circuit elements of the coupling network, a designer can, to some extent, mitigate their effect. The method usually adopted is to start by assuming a network having a form that suggests good frequency characteristics, for it is well known that the better the frequency response characteristics, the better is the transient response. The actual steady-state response characteristics are then calculated and a relation between the components leading to an optimum response is deduced. The method is, however, difficult to apply except to the very simple cases, e.g., linearly-varying phase function and constant-amplitude function. Further, the method does not directly tell us the effects of adjustments of network parameters on the transient response. This difficulty, however, does not arise in the well-known method of transient analysis[1,2]. The response in this case is known directly in terms of zeros and poles of the network function; and, once these are known the network may be completely specified—except for a constant multiplier—by the location of the singularities of the network function.

In the present paper, this method will be adopted to study the transient response of simple coupling networks with three (or four) independent elements. It is found that the results obtained lead more or less directly to the characteristics of ordinary series and shunt-peaked networks. Calculations are also made of the transient response characteristics (as defined in the standard way)—rise-time, overshoot and time-delay.

As we shall consider only the short rise-time case, our study will be restricted to oscillatory cases only. The results will be delineated in a number of graphs in such a way that they will tell directly the type of response of a circuit with given constants, as also the constants of the circuit for a given type of response.

MS accepted by the Editor, November 1953

2. Oscillatory Response to Unit Step: Two-Terminal Network

In actual pulse-amplifier practice, the response may be either non-oscillatory (i.e., monotonic) or oscillatory. In the former the rise of the output voltage is not sharp. An example of such type of response is furnished by the power-pulse driving a magnetron. Here a sharp rise of the voltage pulse is avoided because this may introduce mode-skipping and also, perhaps, instability. An example of the latter type of response is furnished by the pulse amplifiers used in servo-control apparatus. In such cases a sharp rise is desirable and this is achieved by methods like series- and shunt-peaking. It is, however, to be noted that the response with such a sharp rise is usually accompanied by a certain amount of overshoot and subsequent oscillations of the output voltage. However, these effects are usually tolerated for the sake of the sharp rise. The same remark applies to methods of sharpening the trailing edge of a square pulse, as in the case of a hard-valve-pulser-driven magnetron. In what follows, the case of sharp rise accompanied by oscillations will be studied.

The input impedance function or the transfer impedance function of a network, expressed as a function of the complex frequency p may, in general, be written as a ratio of two rational polynomials.

On account of the presence of the input (i.e., anode to cathode) capacitance in the coupling network of an anode-coupled amplifier, the input impedance function of the coupling network will have a zero at $p = \infty$, because the capacitance will represent a short-circuit at infinite frequency. This means that the degree of the numerator must be less than that of the denominator by at least one. Also, for input impedance functions there is the further restriction that the degrees of

the numerator and the denominator can differ at most by one.

The simplest illustrative case, therefore, is that of a function having one zero and two poles. It is evident that the corresponding network, when taken in its simplest form, will have three independent parameters controlling the nature of the network function.

Now, the response of a network having one zero and two poles will be oscillatory only when the poles are complex conjugate. Therefore, if we locate one of the poles the other is at once obtained as the mirror image of this pole on the real axis in the complex frequency plane.

(a) *Calculation of the Response*

Let us assume an input impedance function of the form

$$Z_{in}(p) = \frac{H\,(p+a)}{(p+b)(p+c)} \qquad (1)$$

where H is a constant multiplier, a is a positive real quantity and, according to the criterion of stability, b and c are complex conjugate quantities with positive real parts.

This function has two poles, one on each side of the negative real axis in the complex frequency plane and one zero on the negative real axis.

Let a unit step current input be applied to the circuit. The unit step is defined by the equations

$$\left.\begin{aligned} I(t) &= 1 \text{ for } t>0 \\ &= 0 \text{ for } t<0 \end{aligned}\right\}$$

The Laplacian transform of such a unit step current is given by

$$\mathcal{L}I\,(t) = \frac{1}{p}$$

where the symbol $\mathcal{L}$ stands for the Laplacian transform.

The transform of the voltage developed across the impedance is then given by

$$V_0(p) = \frac{1}{p}\cdot\frac{H(p+a)}{(p+b)\,(p+c)}$$

Hence the output voltage is given by

$$V_0(t) = \mathcal{L}^{-1}\left[\frac{1}{p}\cdot\frac{H(p+a)}{(p+b)\,(p+c)}\right]$$

where $\mathcal{L}^{-1}$ represents the inverse Laplacian transform operation; i.e., the operator

$$\mathcal{L}^{-1}f(p) \equiv \frac{1}{2\pi j}\int_{c-j\infty}^{c+j\infty} f(p)e^{pt}dp.$$

Here $f(p)$ is the function $V_0(p)$ and the integration is performed around an infinite semi-circle. Then,

$$V_0(t) = \sum \text{Residues of } \frac{H(p+a)e^{pt}}{p(p+b)\,(p+c)} = H\left\{\frac{a}{bc} + \frac{(a-b)e^{-bt}}{(-b)\,(c-b)} + \frac{(a-c)e^{-ct}}{(-c)\,(b-c)}\right\}$$

Now, b and c are complex conjugate quantities; let $b = \alpha + j\beta$ and $c = \alpha - j\beta$, then the product bc may be put $= P^2$, a real quantity. The output voltage or the response may then be written:

$$V_0(t) = H\left\{\frac{a}{P^2} + \frac{(a-b)}{b(b-c)}\,e^{-bt} - \frac{(a-c)}{c(b-c)}\,e^{-ct}\right\}$$

or, putting $a\alpha - P^2 = A$; $a\beta = B$; $K = \sqrt{A^2+B^2}$ and $\psi = \tan^{-1} B/A$,

$$V_0(t) = \frac{H}{P^2}\left[a - \frac{e^{-\alpha t}}{\beta}K\sin(\beta t + \psi)\right] \qquad (2)$$

From equation (2) it is clear that if we know α, β and a, the nature of the response function $V_0(t)$ is at once known.

(b) *Condition for the Network to be Physically Realizable* ($0 \leqslant a \leqslant 2\alpha$)

Now, in the input impedance function equation (1) if we put $p = j\omega$ and substitute the values of b and c as given above, we obtain

$$Z_{in} = \frac{H(a+j\omega)}{[\alpha + j(\omega+\beta)]\,[\alpha + j(\omega-\beta)]},$$

the real part of which is equal to

$$\mathrm{Re}[Z_{in}] = \frac{H\{a\alpha^2 - a(\omega^2-\beta^2) + \alpha\omega(\omega-\beta) + \alpha\omega(\omega+\beta)\}}{[\alpha^2+(\omega+\beta)^2]\,[\alpha^2+(\omega-\beta)^2]}$$

For the purpose of investigating the sign of this quantity, the denominator may be left out of consideration, as it is always positive for all real values of ω; the sign will therefore be the same as that of the numerator, which simplifies to:

$$H\{a(\alpha^2+\beta^2) + \omega^2(2\alpha - a)\}$$

Remembering that α, β, a and ω are all real positive quantities, it is seen that for this expression to remain positive for all real values of ω,

$$0 \leqslant a \leqslant 2\alpha \qquad (3)$$

i.e., for a network having two complex poles and a zero to be physically realizable with passive elements, the distance of the zero from the origin can at most be equal to twice the real part of the complex poles.

(c) *Characteristics of the Oscillatory Response for a Special Case*

Let us consider the particular case when the real root of the input impedance function is always situated on the negative real axis at a distance equal to twice the real part of the complex poles; that is, $a = 2\alpha$

Then, we may write the response function of the network as

$$V_0(t) = \frac{H}{P^2}\left[2\alpha - \frac{e^{-\alpha t}}{\beta} R \sin(\beta t + \phi)\right]$$

where $\begin{cases} R\cos\phi = \alpha^2 - \beta^2 \\ R\sin\phi = 2\alpha\beta \end{cases}$

i.e., $R = P^2$

which may also be written as

$$V_0(t) = \frac{H}{P^2}\left[2\alpha - \frac{e^{-\alpha t}}{\beta} R \sin(\beta t + 2\theta)\right]$$

where $\theta = \tan^{-1}\frac{\beta}{\alpha}$

$$= \frac{2\alpha H}{P^2} - \frac{He^{-\alpha t}}{\beta}\sin(\beta t + 2\theta) \qquad (4)$$

The nature of the oscillatory output may now be studied in detail.

The steady final voltage is $= \frac{2\alpha H}{P^2} = \frac{2H\cos\theta}{P}$.

Differentiating the expression for the output voltage with respect to time and equating to zero, we obtain

$$\beta t + 2\theta = \theta + n\pi; \text{ i.e., } \beta t + \theta = n\pi$$

Hence, putting $n = 1$ we obtain for the first maximum

$$t = \frac{\pi - \theta}{\beta}$$

The fractional overshoot of the output voltage over the final steady value may now be calculated from

$$\frac{V_0(t)_{max} - V_0(\infty)}{V_0(\infty)},$$

where $V_0(\infty)$ is the final steady voltage.

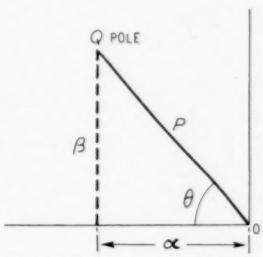

Fig. 1. *Location of pole in the complex frequency plane.*

This gives

$$S = \text{fractional overshoot}$$
$$= \exp[-(\pi - \theta)/\tan\theta]/2\cos\theta$$
$$= f_1(\theta) \text{ say} \qquad .. \qquad .. \qquad .. \qquad (5)$$

The angle θ may be looked upon as the angle which the line joining the origin with the pole (OQ in Fig. 1) makes with the negative real axis. A plot of $f_1(\theta)$ is shown in Fig. 2.

The rise-time may be calculated thus:

It is noted that for all values of S, except the very small ones, the first excursion of the output voltage from the zero value is nearly linear.

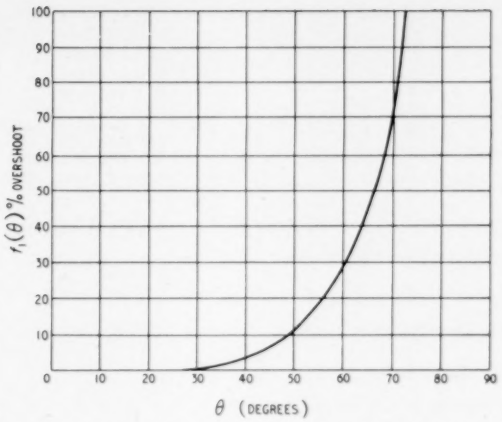

Fig. 2. *Variation of % overshoot $f_1(\theta)$ with the location of poles θ of the impedance function of two-terminal network having two complex poles and one real zero. The zero is situated on the negative real axis at a distance equal to twice the real part of the complex poles.*

The slope of the output voltage is given by

$$He^{-\alpha t}\left[\frac{\alpha}{\beta}\sin(\beta t + 2\theta) - \cos(\beta t + 2\theta)\right] \qquad (6)$$

which at $t = 0$ is equal to

$$H\left[\frac{\sin 2\theta}{\tan\theta} - \cos 2\theta\right] = H$$

Hence, the time required for the voltage to rise to 10% of the final value $\left(= \frac{2\alpha H}{P^2}\right)$ is equal to

$$t_1 = \frac{2\alpha}{10P^2} = \frac{0{\cdot}2\cos\theta}{P} \qquad .. \qquad .. \qquad (7)$$

i.e., $Pt_1 = 0{\cdot}2\cos\theta.$

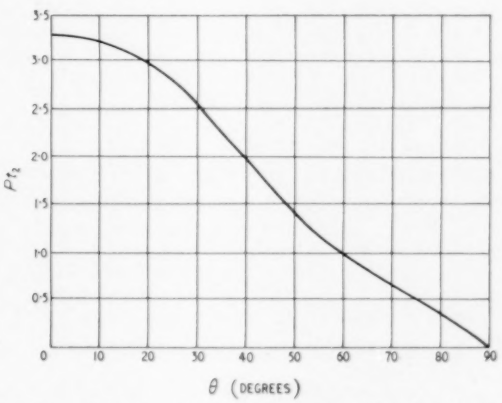

Fig. 3. *Variation of Pt_2 with the location of poles θ.*

The time at which the output voltage reaches 90% of the final value is found by putting the output voltage $V_0(t)$ equal to 0·9 $(2\alpha H)/P^2$

i.e., $$e^{Pt_2\cos\theta} = \frac{10\sin(Pt_2\sin\theta + 2\theta)}{\sin 2\theta}$$

which may now be solved for Pt_2 graphically for different values of θ. This is shown in Fig. 3.

The quantity $(t_2 - t_1)$ is the 10 to 90% rise-time.

A plot of $P(t_2 - t_1)$ is shown in Fig. 4. Let us call this $f_2(\theta)$.

The quantity $\dfrac{2\cos\theta}{P(t_2 - t_1)}H$ is a measure of the gain-rise-time ratio. This is normalized by putting $H = 1$, and is plotted in Fig. 4 as a function of θ.

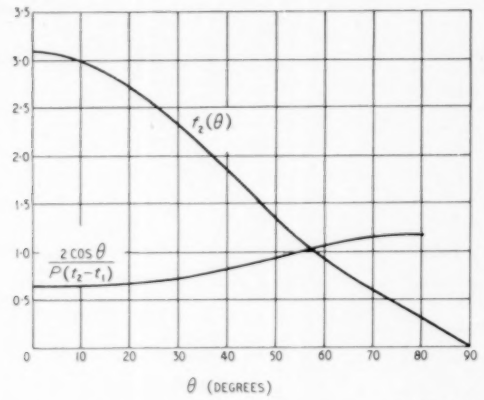

Fig. 4. *Variation of rise-time $P(t_2 - t_1)$ and of $\dfrac{2\cos\theta}{P(t_2 - t_1)}$ with the location of poles θ of the impedance function of a two-terminal network having two complex poles and one real zero. The zero is at a distance twice the real part of the complex poles on the negative real axis.*

The rate of decay of the oscillations is equal to α nepers per second; therefore a decay to 5% of the initial amplitude is equivalent to 2·996 nepers. Hence the time taken for the oscillations to die out to 5% of the initial amplitude is equal to $\dfrac{2\cdot996}{P\cos\theta}$.

Normalizing by putting $P = 1$, this may be written

$$\tau_1 = \frac{2\cdot996}{\cos\theta} = f_3(\theta) \text{ say} \qquad .. \qquad (8)$$

The plot is shown in Fig. 5.

The number of times that the output voltage wave crosses the final level value before the amplitude goes down to 5% can be calculated from the above.

This is:

$$N = \frac{\tau_1\beta}{\pi} = 0\cdot954\tan\theta = f_4(\theta), \text{ say} \qquad .. \qquad (9)$$

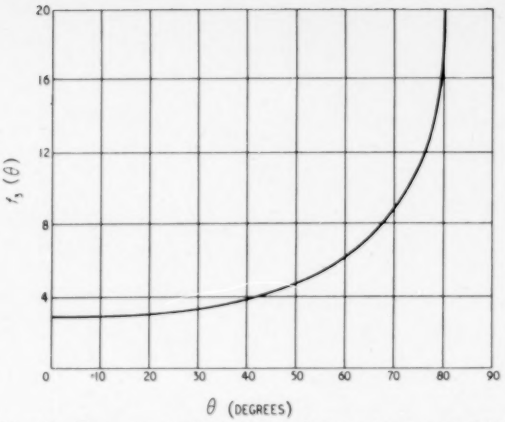

Fig. 5. *Time required for the oscillations to decay to 5% of the initial amplitude $f_3(\theta)$ as a function of the location of poles θ.*

The plot is shown in Fig. 6.

Thus all the important characteristics of the output voltage waveshape can be determined and put in a very convenient graphical form with the locations of the singularities of the network function as the parameters.

(d) *Nature of the Network Elements*

In order to deduce the network corresponding to our assumed function we consider the input admittance. This may be written:

$$Y_{in} = \frac{1}{Z_{in}} = \frac{(p + \alpha + j\beta)(p + \alpha - j\beta)}{H(p + 2\alpha)}$$
$$= \frac{(p + \alpha)^2 + \beta^2}{H(p + 2\alpha)}$$
$$= \frac{p}{H} + \frac{1}{\dfrac{H}{\alpha^2 + \beta^2}(p + 2\alpha)} \qquad .. \qquad (10)$$

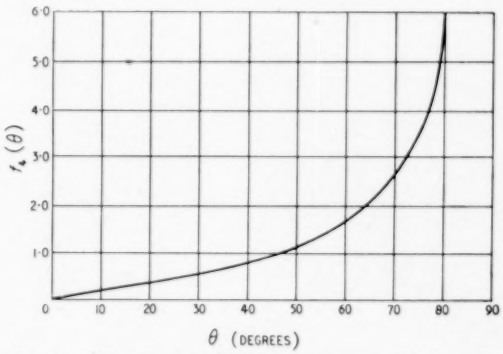

Fig. 6. *The number of times the output voltage wave crosses the final level before the amplitude goes down to 5% of the initial value $f_4(\theta)$ as a function of the location of poles θ.*

The above expression can be identified with a parallel combination of (1) a capacitance C and (2) an inductance L and a resistance R in series. This is shown in Fig. 7.

The values of the components can be related to the constants of the function as follows:

$$C = \frac{1}{H}; \quad L = \frac{H}{\alpha^2 + \beta^2}; \quad R = \frac{2\alpha H}{\alpha^2 + \beta^2} \cdot \cdot \qquad (11)$$

Values of P and θ for the network in terms of its parameters may at once be written down as:

$$\left.\begin{aligned} P &= \frac{1}{\sqrt{LC}}; \quad \theta = \tan^{-1}\sqrt{\frac{4L}{CR^2} - 1} \\ \text{also,} \quad \alpha &= \frac{R}{2L}; \qquad \beta = \frac{R}{2L}\sqrt{\frac{4L}{CR^2} - 1} \end{aligned}\right\} \qquad (12)$$

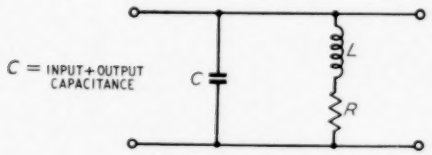

Fig. 7. *Circuit of shunt-peaked amplifier coupling which corresponds to equation* (10).

The above circuit is just the conventional shunt-peaked amplifier coupling network where the anode-to-earth capacitance is represented by C, the load resistance by R, and the peaking inductance by L.

Because, in practice, the anode-to-earth capacitance is not under our control, we have only two parameters to adjust and, therefore, two mutually-independent characteristics of the required response not only suffice for the design but also determine completely the response of the circuit. These may be, for example, gain and rise-time or gain and fractional overshoot, rise-time and fractional overshoot and so on.

(e) *Calculation of the Circuit Constants*

Calculation of the circuit constants will now be illustrated by means of an example.

Let the required output voltage for a unit-step input of 1 V to valve 6AK5 be 10 V (for valve 6AK5, $g_m = 5$ mA/V).

Let the required rise-time be 0·028 μsec and the input capacitance 11·5 pF, also, $H = 1/C$; then the gain-rise-time ratio is equal to 358 μsec^{-1}. Normalizing this by dividing by $(g_m H)$, gives 0·825. From the graph of $2\cos\theta/P(t_2 - t_1)$, which is the normalized gain-rise-time ratio, we find that the value of θ is 40° nearly.

Hence from the plot of S in Fig. 2 the value of percentage overshoot is obtained as 3·5% and from g_m the value of R is obtained as 2,000 ohms.

The actual circuit parameters are therefore given by:

$$P = \frac{1}{\sqrt{LC}} = 0{\cdot}2\text{H} \cos\theta g_m = 66{\cdot}6 \times 10^6$$

$$\therefore \quad L = \frac{1}{P^2 C} = 19{\cdot}6\,\mu\text{H}; \quad R = 2\,\text{k}\Omega$$

If on the other hand we specify the gain as 10 and the fractional overshoot as 11·5%, we obtain from the plot of $f_1(\theta)$ the required value of θ as 50°, and the value of P is obtained from

$$P = \frac{H \cos\theta g_m}{5}.$$

Hence the circuit parameters are:

$$L = \frac{1}{P^2 C} = 27{\cdot}7\,\mu\text{H}; \quad R = 2\,\text{k}\Omega.$$

3. Four-Terminal Network

Coming to the response of four-terminal networks, the restriction that the number of poles should be greater than the number of zeros still remains on account of the input capacitance, but the difference between the number of poles and the number of zeros may now be greater than unity.

Let us consider a transfer impedance function having two poles but no zero, that is, a function of the form

$$\frac{H}{(p + b)(p + c)} \quad \cdot \cdot \quad \cdot \cdot \quad \cdot \cdot \qquad (13)$$

where H is a constant and b and c are complex conjugate with positive real parts as before.

The response of this network to a unit current step applied at the input will be given by

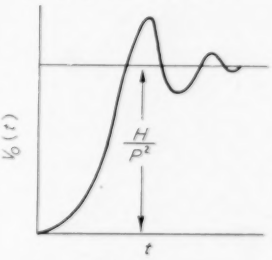

Fig. 8. *Transient response for the transfer impedance function of a four-terminal network having only two complex poles.*

$$V_0(t) = \sum \text{Residues of } \frac{He^{pt}}{p(p + b)(p + c)}$$

If we take $b = \alpha + j\beta$; $c = \alpha - j\beta$, then $bc = \alpha^2 + \beta^2 = P^2$ and

$$V_0(t) = \frac{H}{P^2}\left[1 - \frac{e^{-\alpha t}}{\beta}(\alpha \sin\beta t + \beta\cos\beta t)\right].$$

Putting $\sqrt{\alpha^2 + \beta^2} = P$, and $\tan^{-1}\dfrac{\beta}{\alpha} = \theta$,

we may write

$$V_0(t) = \frac{H}{P^2}\left[1 - \frac{e^{-\alpha t}}{\beta} P \sin(\beta t + \theta)\right] \cdot \cdot \qquad (14)$$

It is seen from the above expression that the final steady output voltage is given by

$$V_0(\infty) = \frac{H}{P^2}.$$

Differentiating expression (14) and equating to zero we obtain for the maximum instantaneous voltage, $\beta t = n\pi$. Hence, putting $n = 0$, we obtain for the first maximum

$$t = \frac{\pi}{\beta}$$

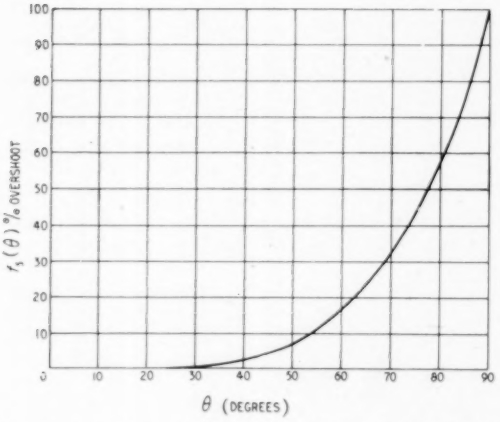

Fig. 9. *Variation of % overshoot $f_5(\theta)$ with location of poles θ for the transfer impedance function of a four-terminal network having only two complex poles.*

The fractional overshoot may be calculated as before; this comes out to be

$$S = \frac{V_0(t)_{max} - V_0(\infty)}{V_0(\infty)} = \exp\left(-\frac{\pi}{\tan\theta}\right) = f_5(\theta) \quad .. \quad .. \quad .. \quad .. \quad .. \quad (15)$$

(shown in Fig. 9).

The slope of the output voltage at the start is zero, as may be seen from expression (14). This means that there is a certain amount of delay in the rise of the voltage. The nature of the output voltage is shown in Fig. 8.

An approximate expression for the rise-time can be deduced from the slope of the curve at the first point of inflexion, by assuming that the slope differs only by a small amount from this value within the region in which the voltage is between 10 and 90% of the final value. The point of inflexion is obtained, as usual, by equating the second derivative of the output voltage to zero.

This gives $\beta t = n\pi + \theta$; i.e., the first point of inflexion is given by $n = 0$, and $t = \frac{\theta}{\beta}$.

The slope at the point of inflexion is, therefore, obtained from expression (14), and is

$$\frac{H}{P}\exp\left(-\frac{\theta}{\tan\theta}\right)$$

Since the final voltage is $\frac{H}{P^2}$, the 10 to 90% rise-time is given by

$$\frac{0{\cdot}8}{P}\exp\left(\frac{\theta}{\tan\theta}\right) = \frac{f_6(\theta)}{P} \text{ (shown in Fig. 10)} \qquad (16)$$

At $t = \frac{\theta}{\beta}$ the voltage is equal to

$$\frac{H}{P^2}\left[1 - 2\exp\left(-\frac{\theta}{\tan\theta}\right).\cos\theta\right]$$

Therefore, the output voltage is 10% of the final value at the instant δ given by

$$\delta = \frac{\theta}{\beta} - \frac{\frac{H}{P^2}\left[0{\cdot}9 - 2\exp\left(-\frac{\theta}{\tan\theta}\right).\cos\theta\right]}{\frac{H}{P}.\exp\left(-\frac{\theta}{\tan\theta}\right)} = \frac{\theta}{P\sin\theta} - \frac{1}{P}\left[0{\cdot}9\exp\left(\frac{\theta}{\tan\theta}\right) - 2\cos\theta\right] = f_7(\theta)/P \quad .. \quad .. \quad .. \quad .. \quad .. \quad (17)$$

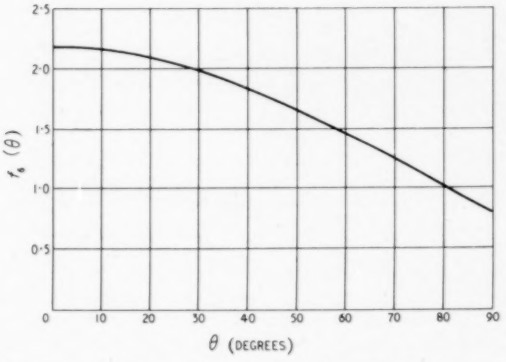

Fig. 10. *Variation of rise-time $f_6(\theta)$ with the location of poles θ for the transfer impedance function of a four-terminal network having two complex poles.*

Normalizing by putting $P = 1$, the delay, defined as the time taken for the voltage to rise to 10% of the final voltage, may be put as:

$$\frac{\theta}{\sin\theta} - 0{\cdot}9\left[\exp\left(\frac{\theta}{\tan\theta}\right) - 2{\cdot}22\cos\theta\right] = f_7(\theta) \quad .. \quad .. \quad .. \quad (18)$$

(shown in Fig. 11)

The time taken for the oscillations to die out to 5% of the initial amplitude and the number of oscillations during this interval have the same functional representation as in the two-terminal case.

It will now be shown that the above function (13) may be made to correspond to the ordinary series-peaked coupling network circuit. This circuit does not include the output capacitance and, hence, is not a very accurate representation of the actual series-peaked circuit. However, the error introduced is small if the output capacitance is not too large, and the method is helpful for an approximate quantitative study of the series-peaked coupling network.

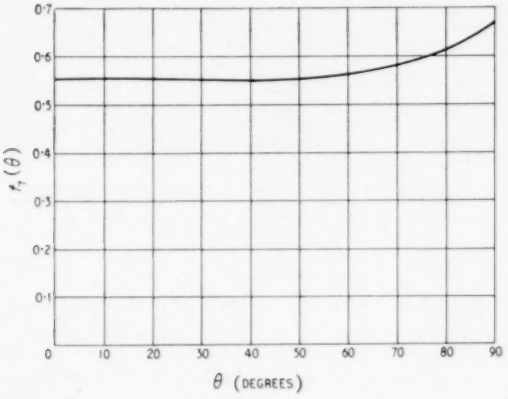

Fig. 11. *Variation of delay $f_7(\theta)$ with the location of poles θ, for the transfer impedance function of a four-terminal network having only two complex poles.*

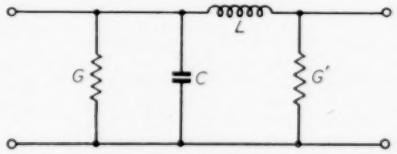

Fig. 12. *Circuit of series-peaked coupling corresponding to equation* (13).

Let us take the circuit shown in Fig. 12. For this circuit the network transform is given by

$$\frac{\text{output voltage transform}}{\text{input current transform}} = \frac{1}{LCG'\left\{p^2 + p\left(\frac{G}{C} + \frac{1}{LG'}\right) + \frac{G+G'}{LCG'}\right\}}.$$

By comparison with our assumed function we may write

$$\left.\begin{aligned} H &= \frac{1}{LCG'}\,;\; P = \sqrt{\frac{G+G'}{LCG'}}\,;\; \alpha = \frac{1}{2}\left(\frac{G}{C} + \frac{1}{LG'}\right) \\ \theta &= \cos^{-1}\frac{1}{2}\,\frac{LGG' + C}{\sqrt{(G+G')LCG'}} \end{aligned}\right\} \quad \ldots \quad \ldots \quad (19)$$

In this case we have four elements in the network of which C is fixed. In order to calculate the three remaining elements therefore, three independent characteristics are necessary.

Calculation of Circuit Constants

Let the amplifier valve be 6AK5 again. We take the sum of the anode-to-cathode capacitance and the next stage input capacitance as 11·5 pF as before, and take the mutual conductance of the valve as 5 mA/V.

Let the required rise-time be 0·03 microsecond; the required gain = 10, and the delay = 0·01 microsecond.

It must be remembered that the rise-time-delay ratio cannot be made to take on just any value. This can be seen from the plot of $f_6(\theta)/f_7(\theta)$ in Fig. 13.

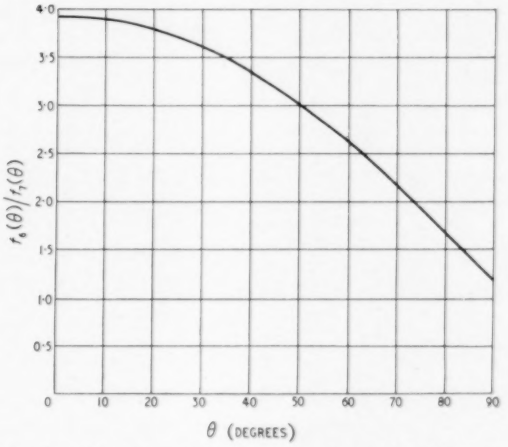

Fig. 13. *Variation of rise-time/delay ratio $f_6(\theta)/f_7(\theta)$ with the location of poles θ, for the transfer impedance function of four-terminal network having only two complex poles.*

Admissible values of this ratio range between 1·2 and 3·9 for the oscillatory output condition.

In the above example, the rise-time-delay ratio is 3. Hence from Fig. 13 the required value of θ is 50°. Also from Fig. 10 the value of $f_6(\theta)$ is = 1·66. $\therefore P = f_6(\theta)/\text{Rise-time} = 55{\cdot}3 \times 10^6$.

Now, $\text{gain} = g_m \dfrac{H}{P^2} = 10 = \dfrac{g_m}{G+G'}$

$$\therefore \quad H = \frac{10P^2}{g_m} = 6{\cdot}12 \times 10^{18}$$

$$\therefore \quad HC = \frac{1}{LG'} = 70{\cdot}4 \times 10^6$$

Again, $\alpha = P\cos\theta = \dfrac{1}{2}\left(\dfrac{G}{C} + \dfrac{1}{LG'}\right)$. From this,

$$\frac{G}{C} = 0{\cdot}6 \times 10^6 \qquad \therefore\ G = 6{\cdot}9 \times 10^{-6}\ \text{mho};$$

i.e., $R = \frac{1}{G} = 0{\cdot}145\ \mathrm{M\Omega}$.

Also, $G' = 0{\cdot}5 \times 10^{-3}$ mho nearly.

$\therefore \quad R' = \frac{1}{G'} = 2\ \mathrm{k\Omega}$.

Hence from the value of $\frac{1}{LG'}$, L comes out to be

$L = 28{\cdot}4\ \mu\mathrm{H}$.

4. Conclusion

The method of design given here may be extended to more complicated coupling networks, but the difficulty is that a general solution for the roots cannot be obtained in terms of the network parameters explicitly when the denominator of the admittance function is of higher degree in p. Though solutions may be obtained for cases where the denominator is a cubic or a quartic in p, the trouble involved on account of the more complicated form of the roots of the denominator is sufficient to render the analysis cumbersome, if not useless.

Graphical methods of solution may, however, be resorted to, and a set of design charts may be obtained. The accuracy of the charts will be sufficient for almost all practical purposes since it is not difficult to keep the errors within 2%.

Acknowledgments

The author is deeply indebted to Prof. S. K. Mitra, for his kind interest in the work and to Mr. Arun K. Choudhury for constant help and guidance. He is also thankful to the Government of India for the award of a scholarship. Thanks are also due to Mr. R. Mittra, for some helpful discussions.

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[1] I. F. Macdiarmid, "Transient Response", *Wireless Engineer*, November 1951, p. 330.

[2] J. H. Mulligan, "Effect of Pole and Zero Locations on the Transient Response of Linear Dynamic Systems", *Proc. Inst. Radio Engrs*, May 1949, Vol. 37, p. 516.

[3] H. W. Bode, "Network Analysis and Feedback Amplifier Design", D. Van Nostrand Company Inc.

MEETINGS

I.E.E.

13th December. "Practical and Economic Problems in the Maintenance of Domestic Television Receivers", discussion to be opened by W. L. Greenwood.

14th December. "An Attracted-Disc Absolute Voltmeter", by G. W. Bowdler, M.Sc. "The Use of an Electron Velocity Analyser to stabilize a 50 kV D.C. Voltage Source to a few parts in a million", by M. E. Haine, M.Sc., and M. W. Jervis, B.Sc.Tech. "A Precision Direct-Current Stabilizer", by M. W. Jervis, B.Sc.Tech.

4th January. "Equipment of Instrumental Accuracy for Recording and Reproduction of Electrical Signals using Cinematographic Film", by H. McGregor Ross, M.A.

The above meetings will be held at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2, and will commence at 5.30.

Brit.I.R.E.

29th December. "Education and Training of Radio Engineers", discussion meeting to be held at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1.

Physical Society's Exhibition

The 1955 exhibition will be held in the New Hall of the Royal Horticultural Society, Westminster, from Monday, 25th April, until Thursday, 28th April, inclusive. It is to be unchanged in character in spite of its change of venue.

Television Society's Exhibition

This annual exhibition will be held from 6th to 8th January in the gymnasium at University College, Gower Street, London, W.C.1. On the first day (6–9 p.m.) admission is limited to members; on the second and third days the hours are noon to 9 p.m. and 10 a.m. to 7 p.m. respectively. Non-members should apply to the Secretary, The Television Society, 164 Shaftesbury Avenue, London, W.C.2.

STANDARD-FREQUENCY TRANSMISSIONS

(Communication from the National Physical Laboratory)

Values for October 1954

Date 1954 October	Frequency deviation from nominal: parts in 10^8		Lead of MSF impulses on GBR 1000 G.M.T. time signal in milliseconds
	MSF 60 kc/s 1429-1530 G.M.T.	Droitwich 200 kc/s 1030 G.M.T.	
1	NM	+3	+36·7
2	−0·9	+4	NM
3	NM	NM	NM
4	−0·9	+4	NM
5	−0·9	+4	+34·1
6	−0·9	+4	+30·3
7	−0·9	+4	+28·4
8	−0·9	+4	+28·0
9	−0·9	+4	NM
10	−0·9	+4	NM
11	−0·9	+4	+22·1
12	−0·9	+4	+20·7
13	−0·9	+5	+19·4
14	−0·9	0	+17·6
15	−0·9	+1	+16·4
16	NM	+1	NM
17	−0·9	0	NM
18	−0·9	−1	+13·1
19	−0·9	+1	+12·6
20	NT	+1	NT
21	−0·9	0	+11·9
22	−0·9	0	+10·8
23	−0·9	0	NM
24	−0·9	+1	NM
25	−0·9	+1	+ 6·5
26	−0·9	+1	+ 5·5
27	−0·9	+1	+ 4·8
28	−0·9	+1	+ 3·7
29	−0·9	+1	+ 4·0
30	−0·9	+1	NM
31	−0·9	0	NM

The values are based on astronomical data available on 1st November 1954.

The transmitter employed for the 60-kc/s signal is sometimes required for another service.

NM = Not Measured. NT = No MSF Transmission.

DATA for the Designers File

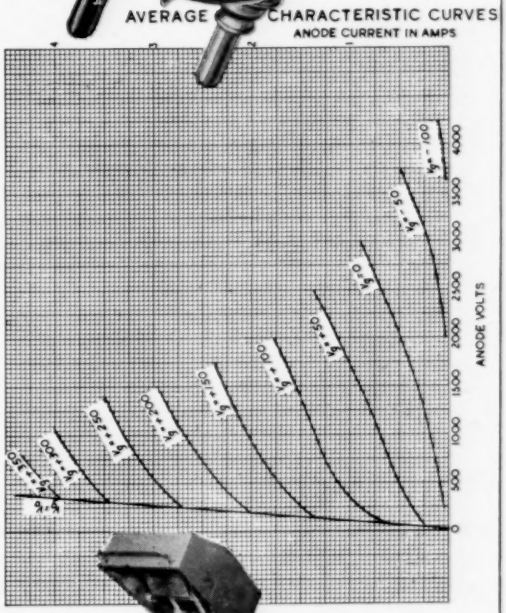
The Ediswan ES.833 is a high mu triode particularly suitable for use as an R.F. Power Amplifier, Oscillator or Class B modulator, and is an excellent valve for industrial R.F. heater equipment.

The anode and grid connections are brought out at the top and are taken through metal to glass seals to heavy current terminals. As a result of this construction the valve is exceptionally efficient at higher radio frequencies and may be operated under class 'C' CW conditions at a maximum input of 2kW at frequencies up to 30 Mcs. At reduced input rating it is possible to operate the valve as high as 75Mcs.

RATING

Filament Voltage (volts)	V_f	10.0
Filament Current (amps)	I_f	10.0
Maximum Anode Voltage (volts)	$V_{a\ (max)}$	*4,000
Maximum Anode Dissipation (watts)	$W_{a\ (max)}$	*400
Amplification Factor	μ	35
Maximum Operating Frequency at full rating		*30 Mc/s

* *Additional cooling will be required when operated at Full ratings at maximum Frequency.*
At higher frequencies anode voltage and input must be reduced.



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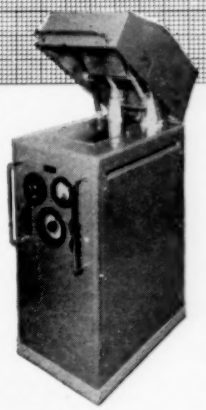

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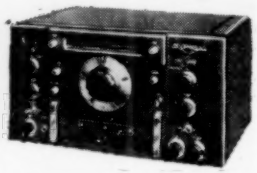

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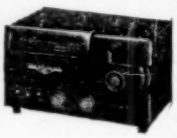

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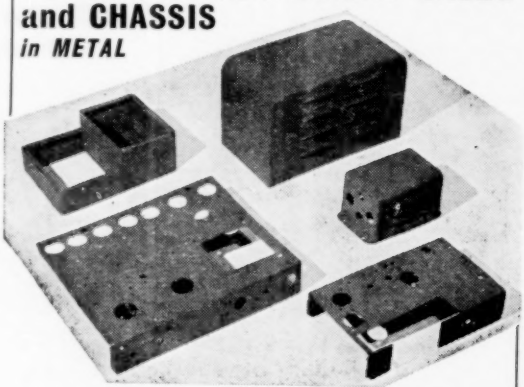

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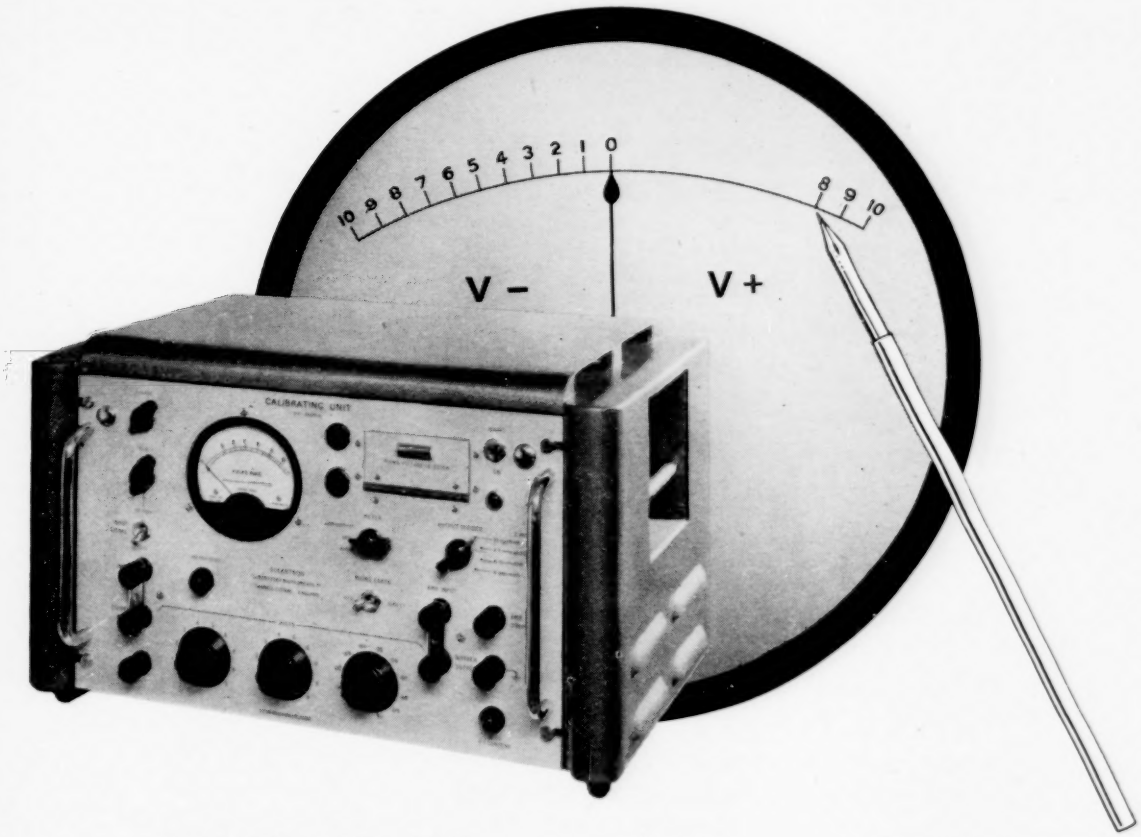

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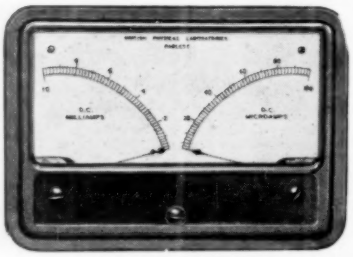

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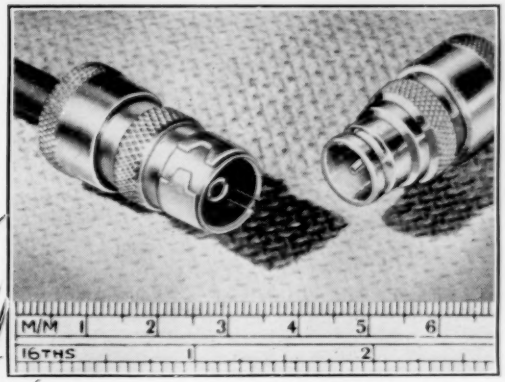

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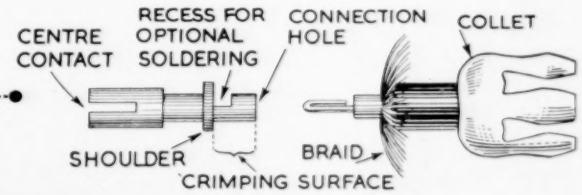

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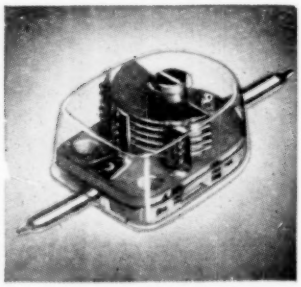

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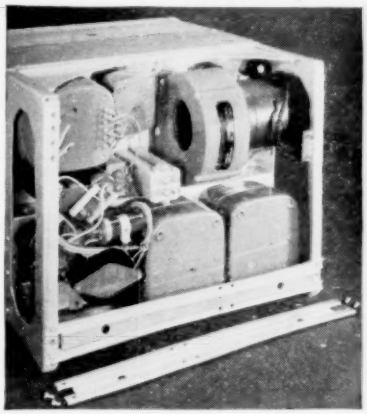
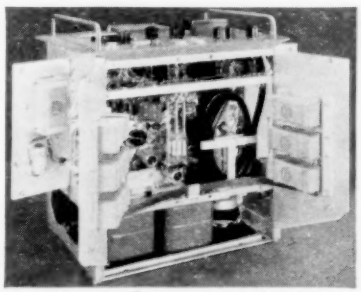
Marconi High Speed Oscilloscope Type TF 942



The efficient centrifugal blower and the hermetically sealed oil-filled transformers of the power unit are typical of the high quality of the components used in the High Speed Oscilloscope.



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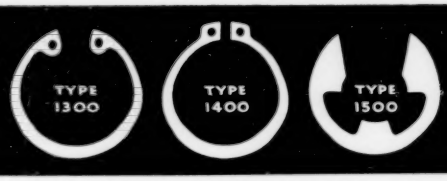

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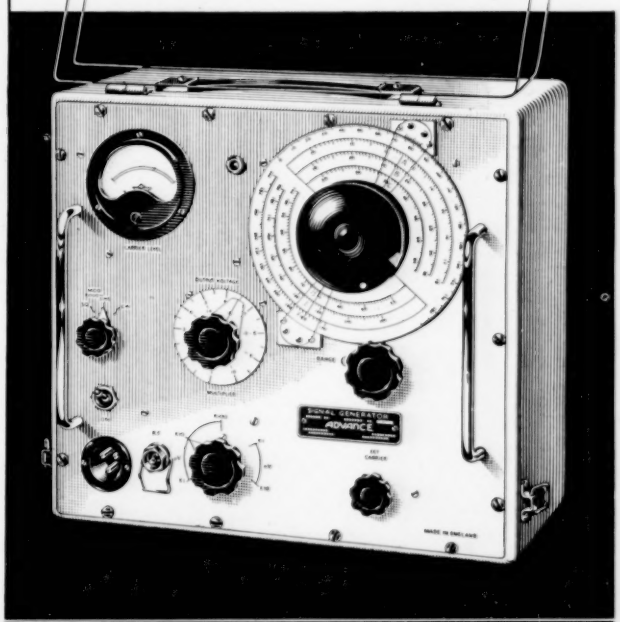

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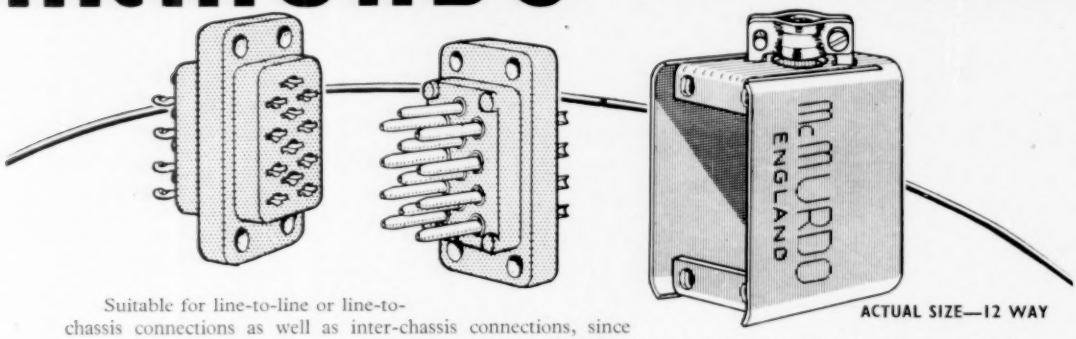

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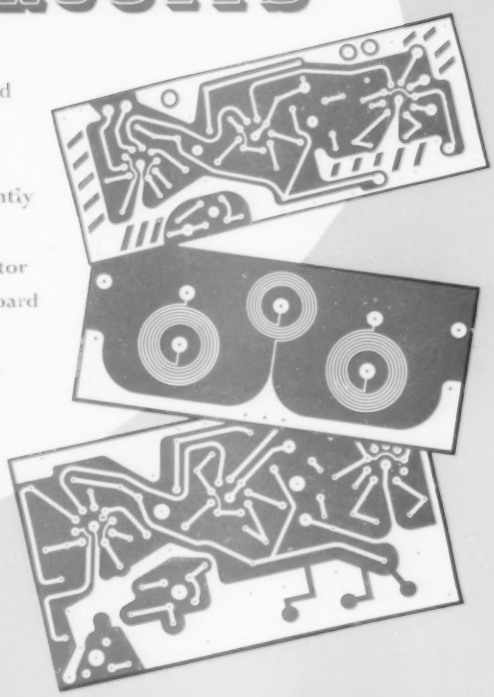

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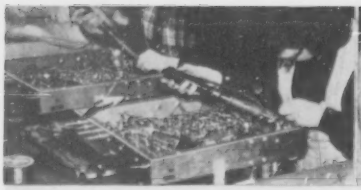

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ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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U.D.C. NUMBERS

A new section has been introduced covering the general technique of electromagnetic waves, oscillations and pulses (i.e., transmission lines and circuits), as distinct from specific applications to telecommunications. The new section is numbered 621.37, with subdivisions. Full details of the new classification, and of the numbers which become obsolete as a result of its introduction, are given in PE Note 535, obtainable from The International Federation for Documentation, Willem Witsenplein 6, The Hague, Netherlands, or from The British Standards Institution, 2 Park Street, London, W.1, England.

Section 621.396.67, dealing with Aerials, has been modified and expanded; details of the new classification are given in PE Note 519.

Section 621.396.96, with subdivisions, has been introduced to cover Radar; details of the new classification are given in PE Note 518.

NEW SUBJECT SECTION

A section headed Automatic Computers has been introduced.

ACOUSTICS AND AUDIO FREQUENCIES

534.231 1

Acoustic Radiation Pressure of Plane Compressional Waves.—F. E. Borgnis. (*Rev. mod. Phys.*, July 1953, Vol. 25, No. 3, pp. 653–664.) See 1878 of 1953.

534.44 : 681.142 : 519.272.1 2

The Correlatograph.—Bennett. (See 58.)

534.793 3

The Audibility of Nonsinusoidal Variations of Pitch.—E. Zwicker. (*Funk u. Ton*, July 1953, Vol. 7, No. 7, pp. 342–346.) A recording audiometer was used in investigations of the limit of audibility of pitch variations due to modulation by triangular or rectangular pulses. The results obtained are shown graphically, together with comparative results for 4-c/s sinusoidal f.m.

534.833.4 : 534.321.9-14 4

Thermal Investigations on the Absorption of Ultrasonic Waves in Liquids.—S. Parthasarathy, D. Srinivasan & S. S. Chari. (*Z. Phys.*, 31st July 1953, Vol. 135, No. 4, pp. 395–402.) Measurements of the heat generated in various organic liquids exposed to ultrasonic radiation of frequencies between 340 and 660 kc/s indicate that the absorption coefficient over this range has the values given by the Stokes-Kirchhoff formula.

534.833.4 : 534.321.9-14 5

The Relation of the Temperature Effect, produced by Ultrasonic Waves in Liquids, to the Absorption Coefficient.—S. Parthasarathy, D. Srinivasan & S. S. Chari. (*Z. Phys.*, 31st July 1953, Vol. 135, No. 4, pp. 403–405.) Measurements indicated that at 5 Mc/s the quantity of heat produced was proportional to the coefficient of absorption for 13 out of 17 organic liquids tested. At 15 Mc/s the quantity of heat produced in 6 liquids was constant and not proportional to the coefficient of absorption. See also 2543 of 1953.

534.84 6

Subjective Comparison of Concert Halls.—T. Somerville. (*B.B.C. Quart.*, Summer 1953, Vol. 8, No. 2, pp. 125–128.) A piece of music with a wide range of tone colour and loudness was recorded, using an omni-directional microphone, in St. Andrew's Hall, Glasgow, the Usher Hall, Edinburgh, the Royal Festival Hall, London, and the Civic Hall, Wolverhampton. Excerpts from the records were presented in a random order to 119 listeners, who were asked for opinions as to (*a*) tone quality, (*b*) definition (the ability to hear the majority of the instruments), (*c*) overall preference. Only groups of skilled listeners gave results having statistical significance. The only valid results of the analysis show a preference for St. Andrew's Hall, with the Royal Festival Hall second.

534.843 7

The Interpretation of Directional-Characteristic Diagrams of Sound Emitters and Receivers.—N. Meyer. (*Funk u. Ton*, Aug. 1953, Vol. 7, No. 8, pp. 398–404.) A method is shown of calculating the effect of the directional characteristic of the source (e.g. voice), the

receiver (e.g. microphone) and the reverberation characteristics of the hall, on the characteristics of the sound transmitted. A practical example is analysed.

621.395.623.7.001.4 **8**

Conditions for Acoustic Testing of Loudspeakers.—P. Chavasse & R. Lehmann. (*Ann. Télécommun.*, July 1953, Vol. 8, No. 7, pp. 226–237.) To specify the acoustic quality of a loudspeaker the following characteristics should be determined: (*a*) frequency response, (*b*) directivity, (*c*) harmonic and intermodulation distortion, (*d*) impedance as a function of frequency, (*e*) efficiency, (*f*) transient response. Specifications for the test chamber and measurement apparatus are suggested and a critical review is made of measurement methods.

621.395.625.3 **9**

Studies on Magnetic Recording: Part 2—Field Configuration around the Gap and the Gap-Length Formula.—W. K. Westmijze. (*Philips Res. Rep.*, June 1953, Vol. 8, No. 3, pp. 161–183.) Analysis is given for heads with (*a*) infinite gap, (*b*) thin gap, (*c*) semi-infinite gap. Part 1: 3471 of 1953.

621.395.625.3 **10**

Correction of Frequency-Response Variations caused by Magnetic-Head Wear.—K. Singer & M. Rettinger. (*J. Soc. Mot. Pict. Telev. Engrs*, July 1953, Vol. 61, No. 1, pp. 1–7.) Wear on a magnet recording head reduces the front-gap to pole-face depth and thereby produces an increase of the gap reluctance. This results in a higher effective bias flux, which tends to attenuate the high frequencies. By reducing the bias current the optimum frequency response can be restored. The relations between the frequency response, head inductance and bias current are shown graphically and the change in sensitivity with change in head inductance is also given.

621.395.625.3 : 621.385.832 **11**

Electron-Beam Head for Magnetic Tape Playback.—A. M. Skellett, L. E. Leveridge & J. W. Gratian. (*Electronics*, Oct. 1953, Vol. 26, No. 10, pp. 168–171.) A reproducing head which is responsive to the instantaneous value of the magnetic flux rather than to its rate of change has a composite magnet system comprising a core structure external to a small c.r. tube (length about 3 in.) with the pole pieces inside the tube and serving to deflect the beam over a split-target signal electrode. The tape record runs over the smoothly curved wings of the core. Typical frequency response curves are shown.

681.84/.85 **12**

Design Interrelations of Records and Reproducers.—H. I. Reiskind. (*Proc. Instn Radio Engrs, Aust.*, Aug. 1953, Vol. 14, No. 8, pp. 196–200; *Trans. Inst. Radio Engrs*, Feb. 1952, No. PGA-5.) The dimensional characteristics of the groove in $33\frac{1}{3}$- and 45-r.p.m. gramophone records are discussed in relation to the recording characteristics. The quality of the reproducer pickup is assessed from intermodulation-distortion measurements made using a 400/4 000-c/s intermodulation signal recorded at various levels.

AERIALS AND TRANSMISSION LINES

621.315.212.4 : [621.395 + 621.397.24 **13**

The Coaxial Cable of the New Italian Communication Network.—R. Monelli. (*Alta Frequenza*, April 1953, Vol. 22, No. 2, pp. 72–97.) The cable system described handles both telephone and television transmissions. Specifications, test methods and preliminary performance figures are given.

621.372.8 **14**

Determination of Reflection Coefficients and Insertion Loss of a Waveguide Junction.—G. A. Deschamps. (*J. appl. Phys.*, Aug. 1953, Vol. 24, No. 8, pp. 1046–1050.) A short-circuit in one of the waveguides is displaced by equal steps of, say, $\lambda/8$ and the corresponding reflection coefficients are measured in the other waveguide, their values, when plotted on the complex plane, falling on a circle. The required parameters are found from the position of points on an image circle derived by application of a bilinear transformation corresponding to the characteristics of the junction.

621.372.8 **15**

'Pipe-Lines' for Microwaves.—(*Elect. Rev., Lond.*, 3rd July 1953, Vol. 153, No. 1, pp. 15–18.) Investigations of multichannel communication and power transmission along tubular waveguides are briefly reviewed. Practical applications are discussed.

621.396.67 : [621.397.5 + 621.396.97.029.6 **16**

Combined Transmitting Aerials for Television and U.S.W. Broadcasting: Part 2.—W. Berndt. (*Telefunken Ztg*, Aug. 1953, Vol. 26, No. 101, pp. 268–279.) Decoupling between the vision and sound transmitters is considered. Eight different aerial-feeding arrangements are discussed. Two practical arrangements of combined television-u.s.w. aerials on one 30-m mast are illustrated and the mismatch/frequency and decoupling/frequency characteristics are shown graphically. Part 1: 37 of 1953.

621.396.674.3.029.62/.63 **17**

Television Aerials of the Future.—F. R. W. Strafford. (*Wireless World*, Nov. 1953, Vol. 59, No. 11, pp. 506–508. Correction, *ibid.*, Dec. 1953, Vol. 59, No. 12, p. 580.) A discussion of problems to be faced in designing aerials for reception over frequency bands I–5 (television and v.h.f. sound), taking into account that horizontally as well as vertically polarized transmissions will be used. Difficulties in respect of propagation losses and energy collection at the higher frequencies are indicated. Possible alternatives are (*a*) a wide-band array covering the whole frequency range, (*b*) separate arrays for selected frequency bands, all permanently connected to the receiver via isolating networks, (*c*) separate arrays with switching arrangements. U.S.A. experience is referred to.

621.396.677 **18**

Gain, Effective Area and Gain Efficiency of Directional Aerials, and Methods for their Determination.—G. F. Koch. (*Telefunken Ztg*, Aug. 1953, Vol. 26, No. 101, pp. 292–308.) A critical survey of the methods used for the determination of gain shows that gain efficiency cannot exceed 100%, though gain efficiencies up to 180% have been reported.

621.396.677.3 **19**

A New Approach to the Design of Super-directive Aerial Arrays.—A. Bloch, R. G. Medhurst & S. D. Pool. (*Proc. Instn elect. Engrs*, Part III, Sept. 1953, Vol. 100, No. 67, pp. 303–314.) The current distribution required for maximum directivity of an array with a finite number of elements and any specified geometrical configuration is completely defined by the self- and mutual resistances of the elements, and by the 'resistance-voltage' component of the voltage across the terminals of each element, this component varying over the array in a specified manner. The maximum gain of the array is expressed either as a double sum containing the mutual conductances between the individual elements multiplied by trigonometrical factors depending on their spacing, or as an expression identical, except for a numerical factor, with that for the distant field of the array. This

theory has been applied to the numerical calculation of certain simple arrays. Directivities greater than those obtained by conventional design methods can be achieved without excessive losses, for arrays of a given size. This was confirmed by experiments on a 75-Mc/s four-element array.

621.396.677.32.029.63 **20**

A New Type of Aerial Radiating Longitudinally.—J. C. Simon & G. Weill. (*Ann. Radioélect.*, July 1953, Vol. 8, No. 33, pp. 183–193.) The theory of end-fire radiation due to variations in phase velocity along a dielectric-rod aerial (1244 of 1953) is developed and the design of all-metal aerials on this principle is discussed. Using a rod of length 4λ with coaxial disks of different diameter at regular intervals along it, a gain of 16 db with s.w.r. $< 1{\cdot}5$ was maintained throughout the frequency range 1·7–2 kMc/s. Values of gain and main-lobe width are given for aerials of length 4, 6, 20 and 80λ.

621.396.677.83 **21**

Tuned Microwave Reflectors.—S. Freedman. (*Radio & Telev. News, Radio-Electronic Engng Section*, Aug. 1953, Vol. 50, No. 2, pp. 13–15, 27.) A flat reflector is provided with specially shaped phase-shifting ends which are tuned by appropriate dimensioning according to the frequency employed and the desired angle of reflection. The resultant phase shift increases the efficiency of the reflector to that of an infinite plane. The relations between efficiency, frequency and direction of reflection are shown graphically. Design considerations are discussed.

AUTOMATIC COMPUTERS

681.142 **22**

Computing Bit by Bit or Digital Computers Made Easy.—A. L. Samuel. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1223–1230.) An introduction to the subject, with explanations of the specialized terminology.

681.142 **23**

Can Machines Think?—M. V. Wilkes. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1230–1234; *Discovery*, May 1953, Vol. 14, No. 5, pp. 151–154.) A general survey of the capabilities and limitations of digital computers.

681.142 **24**

Computers and Automata.—C. E. Shannon. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1234–1241.) Recent developments in the field of automata and non-numerical computers are reviewed; some typical machines, including games-playing machines, are described. A comparison is made between the operation of computers and of the brain.

681.142 **25**

Fundamentals of Digital Computer Programming.—W. H. Thomas. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1245–1249.) The process of programming is explained in relation to a typical but simplified stored-programme computer, using 8 basic instructions. Elementary arithmetical and logical computation are illustrated. The ability of the computer to modify its own programme is demonstrated.

681.142 **26**

Influence of Programming Techniques on the Design of Computers.—G. M. Hopper & J. W. Mauchly. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1250–1254.) New techniques are discussed which take advantage of the high-speed checked operation of the computer to perform the routine work of programming.

681.142 **27**

Analogue vs. Digital Computers—A Comparison.—M. Rubinoff. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1254–1262.) The operation of analogue computers is described. The problem of simulation in real time is used as a basis for comparing analogue and digital computers in respect of speed, accuracy, convenience, etc. The mathematical operations discussed include addition, subtraction, multiplication, division, evaluation of polynomials and other functions, extraction of square roots, and solution of differential equations.

681.142 **28**

The System Design of the IBM Type 701 Computer.—W. Buchholz. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1262–1275.) Attention is directed specially to the new features of this machine, which include improved arithmetic and logical facilities and the control of the extensive input and output arrangements directly from the stored programme. 18-bit instructions cover 33 distinct operations.

681.142 **29**

Engineering Description of the IBM Type 701 Computer.—C. E. Frizzell. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1275–1287.) A detailed description is given of this high-speed computer for large-scale scientific work. A complete installation includes analytical control unit, e.s. storage unit, magnetic-tape and magnetic-drum readers and recorders, punched-card reader, alphabetic printer, punched-card recorder, power distribution unit and power supply unit. A note on maintenance is included. See also 28 above.

681.142 **30**

The Arithmetic Element of the IBM Type 701 Computer.—H. D. Ross, Jr. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1287–1294.) A storage circuit giving a 1-μs delay is described; its output is at either +10V or −30V. Used in conjunction with direct-coupled diode switching, this arrangement leads to simplifications in shifting registers and in performing division and testing for zero in the accumulator.

681.142 **31**

The SWAC [National Bureau of Standards Western Automatic Computer]**—Design Features and Operating Experience.**—H. D. Huskey, R. Thorensen, B. F. Ambrosio & E. C. Yowell. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1294–1299.) This high-speed computer uses a Williams-tube main storage system, an auxiliary magnetic-drum storage system, and punched-card input and output systems. A review is presented of problems solved by the computer during the preceding year. For a less detailed account see *Tech. News Bull. nat. Bur. Stand.*, Oct. 1953, Vol. 37, No. 10, pp. 145–150.

681.142 **32**

SEAC [National Bureau of Standards Eastern Automatic Computer].—S. Greenwald, R. C. Haueter & S. N. Alexander. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1300–1313.) A comprehensive description (see also 385 of 1951) is given of this computer, which has been in operation almost continuously since the spring of 1950. It is a synchronous machine, operating at 1 Mc/s. It has been expanded from its original form, with increase in the number of thermionic valves from about 750 to 1 300, and of Ge diodes from about 10 500 to 16 000. Circuit modifications include the introduction of a.c. coupling using pulse transformers.

681.142 **33**

Electronic Circuits of the NAREC [Naval Research Laboratory Computer].—P. C. Sherertz. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1313–1320.) Crystal diodes are used where practical for all nonlinear functions in this digital computer, thermionic valves being used only for inversion or amplification. All circuits are designed to provide low-impedance output signals whose maximum and minimum levels are held to prescribed potentials. The circuits are packaged in standard 4-valve plug-in units. See also *Elect. Engng, N.Y.*, Feb. 1951, Vol. 70, p. 111 (Gridley & Sarahan).

681.142 **34**

Diagnostic Programmes for the ILLIAC [University of Illinois' digital computer].—D. J. Wheeler & J. E. Robertson. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1320–1325.) A detailed description is given of a 'leapfrog' programme for detecting faults; this ensures that every component of the computer is tested under all the different conditions of use.

681.142 **35**

The Logistics Computer.—R. S. Erickson. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1325–1332.) Construction and operation of a digital computer for logistics research are described. Consideration of the particular requirements for this work led to a design incorporating high-speed magnetic-tape (in addition to punched-tape) input and output equipment, fixed-sequence operation, magnetic-drum storage with capacity for 180 000 decimal digits, and plug-board programming.

681.142 **36**

The Remington Rand Type 409-2 Electronic Computer.—L. P. Crosman. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1332–1340.) Construction and operation are described of a machine of moderate size, for accounting purposes, using 1476 thermionic valves and 1128 cold-cathode gas diodes. Programming is directed by means of plug-boards. There are 40 calculating-steps and 6 special steps; each step is automatically tested by a reverse process. A 'reproduce' feature is included.

681.142 **37**

The Design of the Bendix Digital Differential Analyzer.—M. Palevsky. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1352–1356.) "The error reduction scheme employed by the Bendix Digital Differential Analyzer, which utilizes both ternary intercommunication between integrators and trapezoidal integration, is described. A device for the variation and automatic resetting of initial conditions is discussed together with an example illustrating its operation. Finally, techniques employed for minimizing the size of the computer are considered."

681.142 **38**

Theory of Logical Nets.—A. W. Burks & J. B. Wright. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1357–1365.) Two-valued logic is applied to the study of digital-computer circuits. A 'logical net' is an array constructed from a 'stroke element', representing circuit components performing logical functions, and a 'delay element', representing storage components. Various types of net are defined, their properties are correlated with those of the associated set of equations, and a study is made of the operations they can perform. The classification of digital-computer circuits in this system is discussed.

681.142 **39**

Dynamic Circuit Techniques used in SEAC and DYSEAC.—R. D. Elbourn & R. P. Witt. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1380–1387.) The circuits of these digital computers are standardized on the basis that Ge diodes are used for all logical operations, delay lines for storage, and thermionic valves for amplification. Manufacture is simplified by using only two types of plug-in unit.

681.142 **40**

The Design of Logical OR-AND-OR Pyramids for Digital Computers.—S. E. Gluck, H. J. Gray, Jr, C. T. Leondes & M. Rubinoff. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1388–1392.) Recent improvements in design technique are described, leading to reduction of number of diodes required, reduction of voltage and power requirements, and speeding up of operation. Basic considerations involved in the choice of elements are discussed.

681.142 **41**

A Survey of Digital Computer Memory Systems.—J. P. Eckert, Jr. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1393–1406.) A survey limited to systems whose reaction time is shorter than human reaction time.

681.142 **42**

The Logical Principles of a New Kind of Binary Counter.—W. H. Ware. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1429–1437.) Auxiliary temporary storage in a binary counter is provided, during intervals over which the main storage element is in a state of change, by elements having the same time-indefiniteness as the main storage elements. This leads to a device which has 'true' and 'false' ranks of storage elements. The basic device is generalized to one with four modes of operation, and the rules of number formation are discussed. Application to a computer is described.

681.142 **43**

Combined Reading and Writing on a Magnetic Drum.—J. H. McGuigan. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1438–1444.) A technique is described which uses a single head for storing information and reading it back. Design of a suitable amplifier for this method of operation is discussed. The process can be performed with successive cells at the repetition rate of 60 000/sec. The technique extends the use of magnetic drums to data processing as well as storage.

681.142 **44**

Coded Decimal Number Systems for Digital Computers.—G. S. White. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1450–1452.) "From the very large numbers of possible ways of coding the 10 decimal digits into sets of binary elements, a restricted group of number systems is presented as being particularly adaptable for representing the decimal digits in digital computers. As an example, one number system of this group is presented which permits the construction of a very simple addition circuit."

681.142 **45**

An Electromagnetic Clutch for High Accelerations.—S. M. Oster & L. D. Wilson. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1453–1455.) Unidirectional and bidirectional models are discussed of a clutch with many possible applications in the digital-computer field.

681.142 **46**

A Survey of Analog-to-Digital Converters.—H. E. Burke, Jr. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1455–1462.)

681.142 47

An Analog-to-Digital Converter for Serial Computing Machines.—H. J. Gray, Jr, P. V. Levonian & M. Rubinoff. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1462–1465.) A two-stage process is used, the analogue number being first converted into a 'reflected-binary' or 'cyclic' code number, which is then converted into the binary form as a time sequence with the least significant digit first.

681.142 48

Effectiveness of Two-Step Smoothing in Digital Control Computers.—R. E. Spero. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1465–1469.) The use of a digital computer as an element in a control system, to smooth observational data, is discussed. Analysis is presented for a two-stage system, in which the first stage has a high data-handling rate and short smoothing time while the second has a low data-handling rate and a long smoothing time.

681.142 49

An Input-Output Unit for Analog Computers.—P. R. Vance & D. L. Haas. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1483–1486.) A device is described which operates as a curve-follower type of function generator to provide an input unit, or as an *X-Y* recorder when used as output unit.

681.142 50

Application of Electronic Differential Analyzers to Engineering Problems.—C. A. Meneley & C. D. Morrill. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1487–1496.)

681.142 51

The Solution of Partial Differential Equations by Difference Methods using the Electronic Differential Analyzer.—R. M. Howe & V. S. Haneman, Jr. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1497–1508.)

681.142 : 621.396.822 52

Analog Computing Applied to Noise Studies.—R. R. Bennett. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1509–1513.) Methods suitable for studying both linear and nonlinear systems are discussed.

681.142 53

EDVAC Drum-Memory Phase System of Magnetic Recording.—D. Eadie. (*Elect. Engng, N.Y.*, July 1953, Vol. 72, No. 7, pp. 590–595.)

681.142 54

Dead Programmes for a Magnetic Drum Automatic Computer.—W. L. van der Poel. (*Appl. sci. Res.*, 1953, Vol. B3, No. 3, pp. 190–198.) Breakdown due to a wrong instruction can be prevented by blocking part of the magnetic-drum memory for writing, and placing in this 'dead' part standard sub-programmes which occur frequently.

681.142 55

Electrical Analogues.—G. Liebmann. (*Brit. J. appl. Phys.*, July 1953, Vol. 4, No. 7, pp. 193–200.) Description of the principles, operation and applications of analogue techniques using conducting paper, the electrolyte tank, resistive networks, or networks with both resistive and reactive components.

681.142 : 33 56

Economic Analogs.—O. J. M. Smith. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1514–1519.) Discussion of the possibilities of using analogue computers of various types for solving problems of commerce, industry, etc.

681.142 : 512 57

Elements of Boolean Algebra for the Study of Information-Handling Systems.—R. Serrell. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1366–1380.) Terminology, symbols, definitions, and proofs of basic theorems of Boolean algebra are given as a preliminary to the use of this algebra for studying methods of minimizing the number of physical elements required in information-handling or computing systems. The method is illustrated by examples of design of computer circuits.

681.142 : 519.272.1 : 534.44 58

The Correlatograph.—W. R. Bennett. (*Bell Syst. tech. J.*, Sept. 1953, Vol. 32, No. 5, pp. 1173–1185.) A paper-tape-recorder analogue device for the continuous display of the short-term correlation function by means of a time/time-lag/correlation-factor plot (x-y-intensity) is described. It was designed for the analysis of 200-c/s–4-kc/s signals in a magnetic-tape recording. The electromechanical design is based on the a.f. spectrograph [3517 of 1946 (Koenig et al.)].

681.142 : 538.221 59

A Myriabit Magnetic-Core Matrix Memory.—J. A. Rajchman. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1407–1421.) Description of an experimental information-storage system providing random access to any one of 10 000 bits in a few microseconds. The system is an extension of that previously described by Papian (2258 of 1952). Details are given of the cores, which are of ferromagnetic ceramic material and of diameter 0·054 in., and of the operation of the array.

681.142 : 621.318.5 60

Machine Aid for Switching Circuit Design.—C. E. Shannon & E. F. Moore. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1348–1351.) An experimental special-purpose non-numerical computer for analysis of relay circuits has as its input a relay circuit together with the specification the circuit is intended to satisfy. The analyser checks the circuit against the specification, makes systematic attempts to simplify the circuit by removing redundant contacts, and establishes lower limits for the numbers and types of contact needed to satisfy the specifications. This method is compared with the method in which the same operations are performed by coding them on a general-purpose digital computer.

681.142 : 621.374.5 61

The Mercury-Delay-Line Storage System of the ACE Pilot Model Electronic Computer.—E. A. Newman, D. O. Clayden & M. A. Wright. (*Proc. Instn elect. Engrs*, Part II, Aug. 1953, Vol. 100, No. 76, pp. 445–452.)

681.142 : 621.375.3 62

The Magnetic Amplifier as an Analog Computer Component.—L. J. Craig. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1477–1482.)

681.142 : 621.376.332 63

An A.M.-F.M. Electronic Analog Multiplier.—W. A. McCool. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1470–1477.) A multiplier is described in which frequency deviation and carrier amplitude are made respectively proportional to the two quantities to be multiplied. The product is obtained by means of a Foster-Seeley discriminator. Stabilization is provided by means of feedback. The long-term error is $< 1\%$ of full-scale output.

681.142 : 621.395.34 **64**

Electronic Computers and Telephone Switching.—W. D. Lewis. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1242–1244.) A discussion of the possibility of using digital-computer techniques in automatic telephone switching systems.

681.142 : 621.395.34 **65**

An Automatic Telephone System employing Magnetic Drum Memory.—W. A. Malthaner & H. E. Vaughan. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1341–1347.) The DIAD (drum information assembler and dispatcher) system is described. A capacitive scanner acts as a commutator for conveying signals from subscribers' sets to storage on magnetic drums. These signals are combined with permanently stored information, processed in accordance with built-in programmes, and used to control call-switching circuits. The technical feasibility of the system has been demonstrated by large-scale laboratory experiments.

681.142 : 778.3 **66**

Photographic Techniques for Information Storage.—G. W. King, G. W. Brown & L. N. Ridenour. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1421–1428.) Storage devices with capacities of 10^7–10^9 bits and useful access times can be produced by means of photographic techniques. The difficulty that rapid erasing and rewriting are not possible with photographic media is overcome by providing a small auxiliary unit such as a magnetic-drum store. Flying-spot scanners can be used for reading.

CIRCUITS AND CIRCUIT ELEMENTS

621.314.2.012.3 **67**

Audio Transformer Design Charts.—T. Halabi. (*Electronics*, Oct. 1953, Vol. 26, No. 10, pp. 193–194, 196.)

621.314.22.015.7 **68**

The Design of a Peaking Transformer.—A. B. Thomas. (*J. Brit. Instn Radio Engrs*, Oct. 1953, Vol. 13, No. 10, pp. 486–489.) Reprint. See 2233 of 1953.

621.314.222.026.444 : 621.384.612 **69**

A Wide-Band High-Power Radio-Frequency Transformer.—L. U. Hibbard, W. Raudorf & L. Riddiford. (*J. sci. Instrum.*, July 1953, Vol. 30, No. 7, pp. 245–250.) Detailed description of a transformer forming part of the r.f. system of the Birmingham synchrotron (2092 of 1953). It is designed for operation from a push-pull amplifier and will deliver 10 kVA throughout the frequency range 0·2–10 Mc/s with a duty cycle of 1 sec in every 10 sec.

621.314.7 : 621.375.427 **70**

A Crystal-Triode Push-Pull Amplifier.—J. I. Missen. (*G.E.C. J.*, July 1953, Vol. 20, No. 3, pp. 144–150.) The amplifier described uses two point-contact transistors and is capable of delivering up to 420 mW output power at an efficiency of 28%. A power gain of 12 db at 10% harmonic distortion is obtained.

621.314.7-713 **71**

Kerosene-Cooled Transistors.—J. E. Maynard & R. L. Brock. (*Electronics*, Oct. 1953, Vol. 26, No. 10, pp. 202, 204, 206.) The temperature rise in the contact regions of a point-contact transistor is considerably reduced by circulating kerosene around the junctions; circulation is maintained by the natural convection currents set up.

621.318.4.011/.012 **72**

The Design of High-Q Iron-Cored Inductors.—N. H. Crowhurst. (*Electronic Engng*, Nov. 1953, Vol. 25, No. 309, pp. 478–482.) Design charts are presented for inductors not carrying d.c.; the attainment of maximum Q requires the reduction of overall losses, including those due to core magnetization, to a minimum. For data on inductors carrying d.c., see 1096 of 1951.

621.318.435.3 : 621.314.12 **73**

The Study of a Magnetic Inverter for Amplification of Low-Input-Power D.C. Signals.—E. H. Frost-Smith. (*Proc. Instn elect. Engrs*, Part II, Aug. 1953, Vol. 100, No. 76, pp. 362–371. Discussion, pp. 371–375. Digest, *ibid.*, Part III, Sept. 1953, Vol. 100, No. 67, p. 318.) The principle of operation of the magnetic inverter differs from the conventional magnetic amplifier in that the load current corresponds to the even-harmonic m.m.f.'s present in the asymmetrically excited iron-core system. Power gains up to 10^9 can be obtained with time constants of about 1 sec, when operating at 50 c/s; the zero stability is within 10^{-12} W.

621.318.57 : 621.314.63 **74**

Semiconductor Diode Gates.—L. W. Hussey. (*Bell Syst. tech. J.*, Sept. 1953, Vol. 32, No. 5, pp. 1137–1154.) The general properties of gate circuits are discussed and a simple design analysis of transmission-type and switching-type gates is given. The results of an experimental check are noted, and the suitability of point-contact and junction-type rectifiers for different purposes is discussed.

621.319.43 : 621.317.3 **75**

Study and Evaluation of the Microphony due to Vibration of the Plates of a Variable Capacitor.—E. Briganti. (*Poste e Telecomunicazioni*, Aug. 1953, Vol. 21, No. 8, pp. 363–368.) Capacitance variations due to vibrations are investigated by observing the resulting distortion, the latter being evaluated from the ratio between the third harmonic and the fundamental when a signal of amplitude about 100 V is applied. This ratio is expressed as a function of the Q of the measuring circuit, details of which have been given previously [1035 of 1943 (Brunetti & Greenough)]. The effect of variations of supply voltage is shown in curves.

621.372 **76**

The Fundamental Theorem of Electrical Networks.—J. L. Synge. (*Quart. appl. Math.*, July 1953, Vol. 11, No. 2, p. 215.) A fuller proof is given than that presented in the original paper (347 of 1952).

621.372 **77**

Application of Complex Symbolism to Linear Variable Networks.—A. P. Bolle. (*Tijdschr. ned. Radiogenoot.*, July 1953, Vol. 18, No. 4, pp. 231–246. In English.) The theory developed is based on frequency domain analysis. Equations are derived for networks containing one linear variable element the value of which varies periodically and is capable of being developed in a Fourier series. The usefulness of these equations for computations of magnetic and dielectric modulators and amplifiers is indicated.

621.372.413 **78**

The Utilization of Degenerate Modes in a Spherical Cavity.—M. R. Currie. (*J. appl. Phys.*, Aug. 1953, Vol. 24, No. 8, pp. 998–1003.) Formulae are derived for calculating the coupling coefficients between an arbitrary number of modes excited simultaneously in a cavity resonator. The perfect symmetry of the sphere gives rise to a high degree of degeneracy, i.e., many independent field configurations with the same natural frequency. Experiments on a spherical cavity gave results in good agreement with the theory. Practical coupling devices discussed include irises, loops and small volumes of conductor placed within the cavity. See also 625 of 1952 (Lin).

621.372.413 79

Microwave Cavity Resonators. Some Perturbation Effects and their Applications.—S. K. Chatterjee. (*J. Brit. Instn Radio Engrs*, Oct. 1953, Vol. 13, No. 10, pp. 475–484.) First-order perturbation theory is used to examine the change in resonance frequency and Q of a cavity due to a small deformation of the wall. An expression is derived for the coupling coefficient between the two degenerate modes H_{01} and E_{11}; in the absence of perturbation these two modes can co-exist. Applications of the theory to measurements of dielectric properties, study of ferromagnetic resonance, etc., are described. 33 references.

621.372.5 80

Simplification of the Tensor Analysis of Networks.—J. Thouzéry. (*Radio tech. Dig., Édn franç.*, 1953, Vol. 7, No. 3, pp. 145–161.)

621.372.5 81

Power and Efficiency of Passive Quadripoles.—C. Bordone & G. G. Sacerdote. (*Alta Frequenza*, April 1953, Vol. 22, No. 2, pp. 98–107.) Families of circle diagrams are used to study the output power, efficiency, insertion loss and attenuation of quadripoles.

621.372.5.029.64 : 538.614 82

Investigation of Nonreciprocal Quadripoles in the Centimetre Wave Range.—A. A. T. M. van Trier. (*Tijdschr. ned. Radiogenoot.*, July 1953, Vol. 18, No. 4, pp. 211–229.) Devices based on the Faraday rotation of guided waves are investigated [see, e.g., 1233 of 1952 (Hogan)]; a method is developed for determining the quadripole parameters of these devices. A waveguide arrangement adapted for measurements on gyrators is described; results are given for a gyrator using ferroxcube IV E. Factors to be considered in designing gyrators for particular applications are indicated. See also 2890 of 1953.

621.372.54 83

The Design of Zig-Zag Filters.—T. Laurent. (*Ericsson Tech.*, 1953, Vol. 9, No. 1, pp. 83–108.) Formulae are derived for the computation of a filter with a known distribution of cut-off and peak-attenuation frequencies and given image impedances. The matching conditions between the sections and the method of determining the order of sections in a ladder-network by means of a zig-zag diagram is explained. A numerical example of l.f. band-pass filter design is given.

621.372.54 84

Old and New Methods for designing Composite High-Frequency Filter Circuits and their Application to Filter Circuits with Low Relative Bandwidth.—R. Rücklin. (*Arch. elekt. Übertragung*, Aug. 1953, Vol. 7, No. 8, pp. 363–374.) A calculation based on that given by Edelmann for Tchebycheff-type filters (88 of 1952) is used to extend Schienemann's formulae for multistage filters (2016 of 1939) to the case of finite ripples of the response curve. For low relative bandwidths, simple formulae are derived for the form factors and time constants of the double-circuit stages. As the ripples tend to zero, further simplifications can be introduced. Modification of the method is indicated to deal with cases where large ripples are permitted for the sake of selectivity.

621.372.54 : 517.727 85

Practical Calculation of Jacobi's 'sn' Elliptic Function, with Special Reference to the Determination of the Cauer Parameter for Filters with Operative Attenuation Characteristics.—V. Fetzer. (*Arch. elekt. Übertragung*, Aug. 1953, Vol. 7, No. 8, pp. 393–401.) Elliptic functions encountered in calculations of Tchebycheff-type filters are considered. The method of deriving these functions and hence the attenuation/frequency curve is shown in detail for the case of an antimetrical low-pass filter. Formulae for calculating the functions are tabulated in an appendix.

621.372.54 : 621.372.412 86

Quartz Crystals for Filters.—R. A. Spears. (*A.T.E. J.*, July 1953, Vol. 9, No. 3, pp. 149–157.) Outline account of the characteristics of crystals and their use in filter networks.

621.372.542.4 : 621.396.67 87

Electrical High-Frequency Separating Filter Networks.—R. Becker. (*Telefunken Ztg*, Aug. 1953, Vol. 26, No. 101, pp. 280–291.) Frequency-separating, diplexer and notch-diplexer networks are described. Two classes of frequency-separating networks are distinguished: (*a*) networks with series-tuned circuits in parallel (F_{SP}) and parallel-tuned-circuits in series (F_{PS}), (*b*) parallel-parallel (F_{PP}) and series-series (F_{SS}) tuned-circuit networks. The former are of the frequency-rejector type, the latter of the frequency-acceptor type. The application of theory is shown in several numerical examples of design of transmitter h.f. separating filter networks; the results are compared with the observed characteristics.

621.372.6 88

The Necessary and Sufficient Conditions for the Physical Realizability of a $2m$-Rank Field Impedance (Admittance) Matrix, in the Form of a Passive Multipole.—V. A. Taft. (*C. R. Acad. Sci. U.R.S.S.*, 21st May 1952, Vol. 84, No. 3, pp. 499–501. In Russian.) It is proved that every positive real matrix of $2m$-rank, where m is a finite integral number, can be physically realized in the form of a passive multipole.

621.373.2.029.65 89

A Critical Review of Researches into Millimetric-Wave Spark Generators.—M. H. N. Potok. (*J. Brit. Instn Radio Engrs*, Oct. 1953, Vol. 13, No. 10, pp. 490–497.) Methods using cylindrical and spherical electrodes and arrays of these are discussed; other methods are mentioned. Difficulties involved are indicated. 66 references.

621.373.4 : 621.316.726 90

Magnetic Control of the Frequency of Valve Transmitters by means of an Electrodeless Gas Discharge.—B. Koch & H. Neuert. (*Z. angew. Phys.*, July 1953, Vol. 5, No. 7, pp. 249–251.) The tuned-circuit inductor of an oscillator was wound round an argon-filled spherical container in which an electrodeless discharge could be maintained, and a magnetic field was applied parallel to the plane of the coil. The oscillator frequency was found to vary almost linearly over a certain range of field strengths, and was also dependent on the gas pressure in the discharge vessel.

621.373.42.029.4/.51 91

Bridge-Stabilized Ultrasonic Oscillator.—L. W. Erath. (*Electronics*, Oct. 1953, Vol. 26, No. 10, pp. 174–175.) Good frequency stability and low harmonic distortion are obtained by arranging a Wien-bridge RC oscillator so that no arm of the bridge is shunted by a low impedance. An oscillator with five overlapping ranges covering 1 c/s–120 kc/s is described.

621.373.421.13 : 621.372.412 92

Frequency Stability and Accuracy of a Crystal Oscillator.—E. J. Post & J. W. A. van der Scheer. (*Tijdschr. ned. Radiogenoot.*, July 1953, Vol. 18, No. 4, pp. 183–210.) Properties of crystals relevant to their use for frequency stabilization are reviewed. The occurrence and elimination of crystal oscillations at undesired frequencies are

discussed. Among the factors causing deviation of frequency from the nominal value, the most important is the circuit arrangement; the requirements for satisfactory crystal oscillator circuits are examined in detail. A table indicates the frequency range, maximum instability, maximum inaccuracy, maximum total frequency deviation, and energy output of some known circuits.

621.373.423 : 621.316.726 **93**

Frequency Stabilization of a Reflex-Klystron Oscillator.—F. Bruin. (*Appl. sci. Res.*, 1953, Vol. B3, No. 3, pp. 199–200.) Part of the klystron output is fed to a cylindrical resonator, one of whose ends is constituted by a diaphragm which is vibrated at about 1 kc/s. The detected output from the resonator, which varies with shift of the klystron frequency, is fed to a 1-kc/s lock-in amplifier to produce a control voltage which is added to the klystron reflector voltage.

621.373.431 **94**

The Miller Integrator as Sawtooth-Voltage Generator.—A. Nowak. (*Radio Tech., Vienna*, July 1953, Vol. 29, No. 7, pp. 235–240.) The theory of the Miller integrator is discussed and practical circuits of the transitron and sanatron (an integrator with separate controlling valve) are given. The choice of components and component values is considered in detail.

621.375.024 **95**

The Parallel-T D.C. Amplifier: a Low-Drift Amplifier with Wide Frequency Response.—P. S. T. Buckerfield. (*Proc. Instn elect. Engrs*, Part II, Aug. 1953, Vol. 100, No. 76, pp. 375–376.) Discussion on 982 of 1953. Please note change in U.D.C. number.

621.375.13.018.756 : 621.314.7 **96**

A Transistor Pulse Amplifier using External Regeneration.—J. H. Vogelsong. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1444–1450.) Regenerated pulses having desired waveforms, as required in synchronous serial computers, are obtained by means of a circuit using a point-contact transistor operated as an over-driven amplifier with external feedback. Provision is made for synchronizing the output pulses with a master clock. Transformer coupling provides d.c. restoration.

621.375.221 **97**

Neutralizing Pentodes in Radar I.F. Stages.—J. C. Tellier. (*Electronics*, Oct. 1953, Vol. 26, No. 10, pp. 184–186.) The effects of grid-plate capacitance are cancelled without use of additional components, tapped coils or balanced tuned circuits by using as neutralizing capacitor a screen-bypassing capacitor providing slightly less than complete bypassing. Experimental methods are described for determining the required values of the neutralizing capacitors for radar and television i.f. amplifiers.

621.375.3 **98**

The Magnetic Amplifier.—W. C. Johnson. (*Elect. Engng, N.Y.*, July 1953, Vol. 72, No. 7, pp. 583–588.) Comparison of the elementary magnetic amplifier with the type using external feedback.

621.375.3 **99**

Design of Magnetic Amplifiers.—W. Schmidt. (*Funk u. Ton*, July 1953, Vol. 7, No. 7, pp. 347–358.) An outline of basic design principles.

621.375.5 **100**

Nonlinear Capacitors for Dielectric Amplifiers.—G. S. Shaw & J. L. Jenkins. (*Electronics*, Oct. 1953, Vol. 26, No. 10, pp. 166–167.) The operation of the dielectric amplifier depends on the variation of dielectric constant with applied voltage. Requirements for materials suitable for high-frequency small-signal applications are discussed. A two-stage amplifier with r.f. power supply and gain of 30 db is briefly described.

621.396.6 **101**

New Constructional Techniques.—G. W. Dummer & D. L. Johnston. (*Electronic Engng*, Oct. & Nov. 1953, Vol. 25, Nos. 308 & 309, pp. 417–421 & 456–461.) Survey of modern methods for producing radio equipment, including potting, circuit printing and automatic soldering. 61 references. See also 2926 of 1953.

621.3.066.6 : 537 **102**

Radio Research Special Report No. 24. Fundamental Processes of Electrical Contact Phenomena. [Book Notice]—Jones. (See 122.)

GENERAL PHYSICS

534.01 **103**

On Interaction of Nonlinear Oscillations.—N. Minorsky. (*J. Franklin Inst.*, Aug. 1953, Vol. 256, No. 2, pp. 147–165.) General considerations regarding the existence, stability and certain topological rules of selection between several oscillations are outlined. The results are used to investigate the differential equation

$$\ddot{x} + e(x^2 - 1)\dot{x} + [1 + (a - cx^2)\cos 2t]x = 0$$

using the 'stroboscopic' method (2951 of 1951). Some special cases are examined.

535.215 **104**

The Photoeffect in a Uniform Electric Field.—H. Überall. (*Acta phys. austriaca*, April 1953, Vol. 7, No. 1, pp. 14–22.) It is shown theoretically that even very high external fields have little effect on the angular distribution of the photoelectrons or on the total effective atomic cross-section.

537.122 : [537.291 + 538.691 **105**

Free Electron in an E and H Field.—A. Spork. (*Öst. Z. Telegr. Teleph. Funk Fernsehtech.*, July/Aug. 1953, Vol. 7, Nos. 7/8, pp. 85–98.) The general equations of motion are obtained for an electron in electric and magnetic fields. Particular cases, for various angles between the field and velocity vectors, are considered.

537.122 : 551.510.535 **106**

Experimental Studies of the Motions of Slow Electrons in Air with Application to the Ionosphere.—R. W. Crompton, L. G. H. Huxley & D. J. Sutton. (*Proc. roy. Soc. A*, 23rd July 1953, Vol. 218, No. 1135, pp. 507–519.) From experiments on the motion of slow electrons in air, empirical formulae were deduced from which the electronic temperature, collision frequency, drift velocity and the average energy loss per collision (ΔQ) can be derived. The collision cross-section of molecules of air and nitrogen at electron temperatures up to 2 600°K is directly proportional to the speed of the electrons. The electron collision frequency in the ionosphere up to 94 km is linearly proportional to the pressure. The important result, that ΔQ is proportional to $[(Q - Q_0)/Q]^2$ and not to $(Q - Q_0)$, as believed hitherto, where Q is the agitational energy of the electron and Q_0 the energy of thermal agitation of the gas molecule, is discussed briefly.

537.224 **107**

The Case of Charged Density Distribution versus Semipermanent Polarization as a Basis for Electret Behavior.—W. F. G. Swann. (*J. Franklin Inst.*, Aug. 1953, Vol. 256, No. 2, pp. 167–175.) It is shown that if an electret were composed of ordinary charge distributions, its effects would diminish by 50% in a day or two; the

observed effects indicate the existence of a semi-permanent polarization, and can be regarded as arising from a lag in the cancelling action of conductivity.

537.226 : 539.11 **108**

Investigation between an Electron and a Lattice Oscillator by means of a [one-dimensional] **Model.**—H. Haken. (*Z. Phys.*, 31st July 1953, Vol. 135, No. 4, pp. 408–430.)

537.226.2/.3 : 546.212 **109**

The Dielectric Properties of Water in Solutions.—J. B. Hasted & S. H. M. El Sabeh. (*Trans. Faraday Soc.*, Sept. 1953, Vol. 49, No. 369, pp. 1003–1011.) Measurements have been made of the microwave dielectric constants and losses of water and some aqueous solutions over the temperature range 0–60°C, using methods described by Collie et al. (2508 of 1948). The dielectric constant of water at cm λ rises from $5{\cdot}0 \pm 0{\cdot}5$ at 0°C to $5{\cdot}9 \pm 0{\cdot}5$ at 60°C. Results for the solutions are tabulated and their interpretation is discussed.

537.228.1 **110**

The Linear Piezoelectric Equations of State.—R. Bechmann. (*Brit. J. appl. Phys.*, July 1953, Vol. 4, No. 7, pp. 210–212.) The different forms of the equations of state obtained from various combinations of stress, strain, electric field, electric displacement and polarization are given in tabular form.

537.311.33 **111**

Electro-thermal Behaviour of Point Contacts to Semiconductors.—A. D. Stuckes. (*Proc. phys. Soc.*, 1st July 1953, Vol. 66, No. 403B, pp. 570–587.) Joule heating effects, due to current flow through a point contact to a semiconductor with no barrier layer, were investigated theoretically and the results were confirmed experimentally for tungsten points in contact with sintered disks of Mg_2TiO_4. The values of the contact radius calculated from d.c. and a.c. experiments are in fair agreement, as are the calculated and measured variations with frequency of the impedance to sinusoidal ripple superimposed on steady current. Minor anomalies in the d.c. characteristic are assumed to be due to field emission around the contact.

537.52 **112**

The Ignition Voltage of Gas Discharges in a Transverse Magnetic Field over the Pressure Range $10–10^{-8}$ Torr.—R. Haefer. (*Acta phys. austriaca*, April 1953, Vol. 7, No. 1, pp. 52–90.) Experiments were made using a discharge space bounded by coaxial cylinders, with a coaxial magnetic field. A voltage of 2·2 kV was sufficient to start a discharge at $1{\cdot}5 \times 10^{-8}$ Torr with a suitable magnetic field strength. On the basis of these measurements and those of other workers, expressions are derived relating ignition voltage to magnetic field strength, electrode separation (d) and configuration, electrode material, nature and pressure (p) of the gas. Above a critical value of pd (1·07 Torr cm for air) the magnetic field raises the ignition voltage; below this critical value the magnetic field reduces the ignition voltage.

537.525.72 **113**

The Growth of the High-Frequency Electrodeless Discharge.—G. Francis & A. von Engel. (*Phil. Trans. A*, 9th July 1953, Vol. 246, No. 909, pp. 143–180.) The various stages in the growth of electrodeless discharges are discussed in detail, with particular consideration of electron-multiplication processes, increase of the number of positive ions, and the effect of charges on the wall of the discharge tube. A new experimental technique for measuring the discharge current is described in which the large capacitive current across the external electrodes is balanced in a bridge circuit, so that when a discharge occurs the unbalanced voltage, after amplification and rectification, can be used to give a proportionate representation of the value of the discharge current on a c.r.o. For measurement of the growth of the current with time, h.f. voltage pulses are applied to the discharge tube and the timebase of the c.r.o. is synchronized with the pulses. Oscillograms show how the growth of current depends on the pressure (2–35 μ), the nature of the gas (H and He), the excess voltage and the frequency of the applied field (10–20 Mc/s). In the initial stage the properties of the tube walls mainly control the multiplication process and thus the starting field. In the later stages the properties of the gas become important and so determine the total time of growth of the discharge. For previous work see 2500 of 1949 (Gill & von Engel).

537.533.8 : [546.46-31 : 548.55 **114**

Secondary Electron Emission of Crystalline MgO.—J. B. Johnson & K. G. McKay. (*Phys. Rev.*, 1st Aug. 1953, Vol. 91, No. 3, pp. 582–587.) Single crystals of MgO in bulk form, cleft along the (100) plane were used. The maximum secondary-emission ratio is about 7 at room temperature and with a bombarding voltage of about 1·2 kV. No correlation between conductivity and yield was established. Increase in temperature led to a decrease in yield. The most probable energy of emission is about 1 eV. Theoretical considerations based on band theory support these observations.

537.56 **115**

Collisional Effects and the Conduction Current in an Ionized Gas.—K. C. Westfold. (*Phil. Mag.*, July 1953, Vol. 44, No. 354, pp. 712–724.) A first approximation to the transport equation for the conduction current in a binary ionized gas is derived. The collision damping factor derived is a weighted mean of the electron and ion collision frequencies, which is 4/3 times the electron collision frequency. Corresponding approximations made to the equations of conservation, motion and thermal energy, when combined with Maxwell's equations, yield a set of equations for the investigation of the interactions between an ionized gas in motion and the associated radiation field. The results are applicable to the solar atmosphere and the H I, H II and lower ionosphere regions.

538.122 **116**

The Magnetic Fields Produced by Uniformly Magnetized Ellipsoids of Revolution.—H. J. Peake & N. Davy. (*Brit. J. appl. Phys.*, July 1953, Vol. 4, No. 7, pp. 207–209.) Formulae, graphs and tables are given for the numerical evaluation of the field strengths in the equatorial plane and on the magnetic axis of prolate and oblate spheroids.

538.24 : 548.55 **117**

The Influence of Domain Structure on the Magnetization Curves of Single Crystals.—E. W. Lee. (*Proc. phys. Soc.*, 1st July 1953, Vol. 66, No. 403A, pp. 623–630.) Néel's model for the domain structure of a single crystal of iron in the form of a strip parallel to the (110) direction was used in the calculation of magnetization curves. The I/H curves depend explicitly on the width of the crystal. Comparison between the calculated curve and experimental results for a 3·85% Si/Fe crystal shows good agreement, particularly at low field values.

538.52 **118**

Induction Phenomena consequent on the Movement of Material in Primary Magnetic Fields, and their Experimental Applications: Part 1—Experimental Bases.—H. Hinteregger. (*Acta. phys. austriaca*, April 1953, Vol. 7, No. 1, pp. 1–13.) Discussion of 'unipolar induc-

tion', using this term in its broad original meaning, viz., induction of electricity due to movement of material in a magnetic field. Simple experiments demonstrating the basic phenomena are described.

538.521 119

Induction in a Conducting Sheet by a Small Current-Carrying Loop.—J. R. Wait. (*Appl. sci. Res.*, 1953, Vol. B3, No. 3, pp. 230–236.) Analytical solutions are derived for the cases where the loop axis and the plane of the conducting sheet are (*a*) mutually perpendicular, (*b*) parallel. The results are applicable to problems of electrical shielding and prospecting.

538.56 : 517.9 120

An Identity leading to a Solution of Kirchhoff's Problem for Damped Waves.—E. Durand. (*C. R. Acad. Sci., Paris*, 28th Sept. 1953, Vol. 237, No. 13, pp. 647–649.)

539.232 : 537.311.1 121

Electron Currents in Thin Oxide Films on Aluminium.—A. Charlesby. (*Proc. phys. Soc.*, 1st July 1953, Vol. 66, No. 403B, pp. 533–541.) At low electric-field intensities, the electron current in films formed on Al in suitable electrolytes depends on the temperature and on the hyperbolic sine of the product of the field strength and a constant dependent on barrier dimensions. The oxide-film barrier height and trough-to-peak width are 0·61 eV and 1·1–1·4 Å respectively. The theoretical current/voltage curves given show good agreement with experimental results. The origin of the electron current and the presence of trapped charges in the oxide layer near the electrolyte surface are discussed.

537 : 621.3.066.6 122

Radio Research Special Report No. 24. Fundamental Processes of Electrical Contact Phenomena. [Book Notice]—F. L. Jones. Publishers: H.M. Stationery Office, London, 1953, 3s. (*Govt Publ., Lond.*, July 1953, p. 27.) For a summarized account see *Beama J.*, Sept. 1953, Vol. 60, No. 195, pp. 293–295.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

521.038 : 537.525 123

Conditions for the Occurrence of Electrical Discharges in Astrophysical Systems.—J. W. Dungey. (*Phil. Mag.*, July 1953, Vol. 44, No. 354, pp. 725–738.) Theoretical considerations of a large ionized mass of gas in motion show that neutral points of the magnetic field are unstable, so that a small perturbation will start a discharge. The orbits of particles in the field are considered; particles with very large energies may be involved. Such discharges may account for aurorae and may also occur in solar flares and the interstellar gas.

523.5 124

The Length of Ionized Meteor Trails.—L. A. Manning, O. G. Villard, Jr, & A. M. Peterson. (*Trans. Amer. geophys. Union*, Feb. 1953, Vol. 34, No. 1, pp. 16–21.) The length of the meteor ionization column is defined as the distance between the most widely separated points along the trail from which normal-incidence radio reflections can be obtained, using a radar system of prescribed characteristics. A statistical study is made of the length distribution of trails, based on measurements made at two observation stations spaced 100 km apart and operating with a c.w. output power of about 1 kW on 23 Mc/s. The mean trail length found was 25–30 m; meteors up to the sixth magnitude were detected.

523.8 : 621.396.822 125

Cosmic Origin of Radiation at Radio Frequencies.—F. Hoyle. (*Nature, Lond.*, 15th Aug. 1953, Vol. 172, No. 4372, pp. 296–297.) Discussion of possible ways in which r.f. radiation from stellar sources may be produced.

523.854 : 621.396.822 126

Some Fundamental Results and Problems of Radio Astronomy.—H. H. Klinger. (*Funk u. Ton*, July 1953, Vol. 7, No. 7, pp. 359–368.) A clear and concise survey of measurement techniques is given, together with a discussion of the theories of the origin of r.f. radiation from the sun and the radio stars. The results of measurements of the line emission of interstellar hydrogen on a wavelength of 21 cm are briefly discussed in relation to the problem of the structure of the Milky Way.

537.56 127

Collisional Effects and the Conduction Current in an Ionized Gas.—Westfold. (See 115.)

538.71 128

Note on a Proposed Three-Component Aeromagnetometer.—V. B. Gerard. (*N.Z. J. Sci. Tech.*, July 1953, Vol. 35, No. 1, pp. 1–3.) By identifying stars photographed with a small nonmagnetic camera mounted on the fluxgate gimbal mechanism of a total-force aeromagnetometer, it is possible to find the magnetic declination and dip.

551.5 : 621.396.11 129

Conference on Radio Meteorology.—(*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1534–1541.) Summaries are given of 61 papers for presentation at the conference at the University of Texas, November 1953.

551.510.535 130

Exploring the Ionosphere by means of Rockets.—E. Burgess. (*Electronic Engng*, Nov. 1953, Vol. 25, No. 309, pp. 469–470.) Summaries are given of papers presented at a conference held at Oxford under the auspices of the Royal Society.

551.510.535 131

The Charge on the Ionosphere.—J. A. Chalmers. (*J. atmos. terr. Phys.*, July 1953, Vol. 3, No. 6, pp. 345–346.) The total charge on the inner side of the ionosphere is shown to be zero.

551.510.535 132

Study of the Ionospheric D Region using Partial Reflections.—F. F. Gardner & J. L. Pawsey. (*J. atmos. terr. Phys.*, July 1953, Vol. 3, No. 6, pp. 321–344.) 2·28-Mc/s pulse-echo observations were made with a transmitter of peak power ~ 1 kW and with the receiver located where the noise level was very low. Results showed that below the E layer there were two reflection regions, (*a*) a region of greater electron density around 90 km extending up to the normal E layer, and having minimum ionization at noon, (*b*) a region around 70 km where a distinct ionized layer forms during the day, attains a maximum ionization at noon and disappears at night. In echoes from this region both magneto-ionic components were present, the extraordinary being the stronger. The ratio of the two magneto-ionic components of a discrete echo at a particular range was, within the uncertainty of observation, independent of fading, but varied with time of day and from day to day. From this ratio the collision frequency and electron density for this range of heights were determined.

551.510.535 133

Two Cases of Large F_2-Region Disturbance associated with Small Magnetic Disturbance.—B. Hardwick. (*J.*

atmos. terr. Phys., July 1953, Vol. 3, No. 6, pp. 347–349.) During Oct. 26–27, 1947, at Canberra and Brisbane, and, to a lesser extent, at other places in this area of the world, hourly values of f_0F_2 and $h'F_2$ showed departures from monthly median values typical of those observed during a considerable magnetic storm. The days in question were international quiet days. Two other, though less striking, cases have been found from analysis of the records.

551.510.535 **134**

The Distribution of F_2 Region-Ionization at High Latitudes.—J. C. W. Scott. (*J. atmos. terr. Phys.*, July 1953, Vol. 3, No. 6, pp. 289–294.) The linear relation $f_0F_2 = a + bs$ between critical frequency and sunspot number is found to hold with reasonable accuracy in the Arctic. Contour charts of a and b have been prepared in coordinates of latitude and longitude for fixed hours and months. Typical examples are shown, and the general features, particularly the effects of the auroral zone and geographical factors, are pointed out.

551.510.535 : 523.74 **135**

Some Statistical Results on the Phenomena associated with Ionospheric Storms.—D. W. G. Chappell, L. B. Hainsworth & I. M. Moorat. (*J. atmos. terr. Phys.*, July 1953, Vol. 3, No. 6, pp. 301–320.) Data covering the years 1941–1949 on (*a*) f_0F_2, (*b*) height of maximum ionization of the F_2 layer, and (*c*) absorption in lower layers, were analysed to determine the probability that a particular day will be a storm day for a given set of solar conditions. A day is considered to be a storm day if the mean variation of these three parameters studied separately in relation to the effects of sunspots, M regions and solar flares, is such as would cause a 10% fall in m.u.f. or a 10% rise in l.u.f. Positive results were obtained only for the parameter f_0F_2. Except for storms associated with M regions at sunspot minimum, the probability that a given day will be a storm day does not exceed 0·5 for the first day of a storm but may reach 0·7 on subsequent days. It is concluded that only during the sunspot minimum period can ionospheric storms be forecast on solar data alone.

551.510.535 : 523.78 **136**

The Ionosphere during the Partial Solar Eclipse observed at Buenos Aires, 20th August 1952.—I. Ranzi. (*Alta Frequenza*, April 1953, Vol. 22, No. 2, pp. 59–71.) The decrease in the number of free electrons in the F_1 layer during the eclipse was mainly due to ion recombinations. A simultaneous decrease in the F_2 layer was preceded by an appreciable increase. The two layers were clearly separated, indicating a high recombination coefficient above the F layer. Rapid decrease of the critical frequencies of both layers was observed during the occultation of two sunspots.

551.510.535 : 537.122 **137**

Experimental Studies of the Motions of Slow Electrons in Air, with Application to the Ionosphere.—Crompton, Huxley & Sutton. (See 106.)

551.510.535 : 621.396.11 **138**

Typical Scattering of Radio Waves by Electron Clouds in the Sporadic-E Layer.—W. Becker. (*Arch. elekt. Übertragung*, Aug. 1953, Vol. 7, No. 8, pp. 375–378.) The three main types of scattering deduced by Eckersley (2881 of 1940) from fixed-frequency observations are confirmed by specially selected records of swept-frequency echo soundings made at Lindau.

551.578.11 **139**

The Relation between Rain Current and Rate of Rainfall.—A. C. Best. (*J. atmos. terr. Phys.*, July 1953, Vol. 3, No. 6, pp. 285–288.) Consideration of the drop-size distribution in rain (2215 of 1950 and *Quart. J.R. met. Soc.*, 1950, Vol. 76, p. 302) leads to a relation very similar to the first of Simpson's formulae (*Geophys. Mem.* No. 84).

551.594.2 **140**

The Effective Separation of Discharging Points.—J. A. Chalmers. (*J. atmos. terr. Phys.*, July 1953, Vol. 3, No. 6, pp. 346–347.) The effective separation, i.e. that spacing of points in rectangular array which would give the same current density as actually occurs with an earth-connected point in discharges of atmospheric electricity, is 11 m for high field strength.

551.594.5 **141**

The Aurorae.—V. C. A. Ferraro. (*Advances Phys.*, July 1953, Vol. 2, No. 7, pp. 265–320.) General characteristics of aurorae are described and the connection between aurorae and both solar activity and geomagnetism is shown. The auroral spectrum is discussed and various theories of the aurora are critically reviewed.

551.594.6 **142**

An Investigation of Whistling Atmospherics.—L. R. O. Storey. (*Phil. Trans. A*, 9th July 1953, Vol. 246, No. 908, pp. 113–141.) A comprehensive report of an experimental and theoretical study of whistling atmospherics, at frequencies <15 kc/s is given. Whistlers may or may not be preceded by ordinary atmospherics, produced by lightning strokes at a distance of $\sim 2\,000$ km. The diurnal and annual variations of the properties of both types were investigated. Explanatory theory of their origin advanced by Eckersley (958 of 1935) is developed. Measurements of the degree of dispersion indicate an electron density in the upper atmosphere considerably larger than expected. This result is explained on the assumption that electrons are falling in from outside, and this might account for the relation between the occurrence of whistlers and magnetic activity.

LOCATION AND AIDS TO NAVIGATION

621.396.93 **143**

Some Practical Measurements of the Relative Performances of a Cyclical Phase-Comparison Type of Direction-Finder and a U-Adcock Instrument.—H. G. Hopkins & E. N. Bramley. (*Proc. Instn elect. Engrs*, Part III, Sept. 1953, Vol. 100, No. 67, pp. 263–267.) Simultaneous bearing observations were made with a c.r. U-Adcock direction finder and a multi-aerial wide-aperture instrument (PV2) using cyclical differential measurement of phase. The transmitters observed operated in the range 8–12 Mc/s and were located at distances between 750 and 1 500 km. In the analysis of the data, where particular attention was paid to the rapidly varying component of the bearing changes, the spread of bearings was, in general, significantly greater with the Adcock direction finder. The superiority of the PV2 instrument was, by inference, due to the relatively large aerial spacing. Although the Adcock direction finder gave the better performance in the presence of interfering signals, a higher proportion of observations were lost with it owing to deep fades.

621.396.93 : 621.396.677 **144**

The Calculation of Wave-Interference Errors on a Direction-Finder employing Cyclical Differential Measurement of Phase.—W. C. Bain. (*Proc. Instn elect. Engrs*, Part III, Sept. 1953, Vol. 100, No. 67, pp. 253–261.) Expressions are derived for the mean-square error due to wave interference as the phase difference between

two incident rays varies, and also for the case where the bearing separation of the two rays varies. From the expressions obtained, graphs are constructed showing the variation of r.m.s. error (*a*) with system aperture, (*b*) with amplitude ratio of incident waves, (*c*) with bearing separation of rays, (*d*) with angle of elevation of the weaker ray. The corresponding errors for an Adcock direction finder are also plotted for comparison. When angles of elevation of the two rays are the same, apertures greater than 20λ will be required to give a substantial reduction in these errors, but where the angles of elevation differ, apertures of 4λ will give sufficient error reduction.

621.396.93 : 621.396.677 **145**

Effective Polarization on Elevated-Aerial Direction Finders.—D. W. G. Byatt. (*Marconi Rev.*, 3rd Quarter 1953, Vol. 16, No. 110, pp. 128–133.) In general no simple standard-wave error can be quoted for an elevated aerial of U-Adcock or similar type due to the rotation of the plane of polarization. Field conditions at an elevated receiving aerial have been investigated, using a transmitter at different heights operating on 130 Mc/s. For an H-type aerial system at a height 4λ a signal tends to preserve its original plane of polarization for angles of incidence below $\sim 20°$. If the reflecting surface is of high conductivity and permittivity the corresponding angle is $\sim 6°$.

621.396.93.088 **146**

The Octantal Error in a Phase-to-Amplitude Conversion Circuit.—D. H. Shinn & D. W. Watson. (*Marconi Rev.*, 3rd Quarter 1953, Vol. 16, No. 110, pp. 121–127.) The two direct currents derived in the conversion circuit for operating the bearing meter of the Marconi v.h.f. d.f. equipment Type AD200, are not exactly proportional to the sine and cosine of the phase angle between the 25-c/s input voltages. Analysis shows that the error involved is approximately octantal, depends on the phase difference and the amplitude ratio of the input voltages, and has a maximum value of 3·16°. Operating conditions are chosen such that this error cancels most of that due to aerial spacing.

621.396.933 : 526 **147**

The Use of Loran for Survey Work in the Pacific.—J. O. Clarke. (*J. Inst. Nav.*, July 1953, Vol. 6, No. 3, pp. 307–312.) The errors likely to occur in loran fixes are discussed. Loran was found particularly useful in survey work between Japan and New Guinea.

621.396.96 : 534.241 **148**

Audar.—R. H. James. (*Electronic Engng*, Nov. 1953, Vol. 25, No. 309, pp. 451–455.) An audio system designed to demonstrate radar principles is described. 1-ms pulses of sound of frequency 6 kc/s are radiated by a highly directional loudspeaker, which also serves as receiver for echo signals. These are rectified and used to provide a conventional c.r.o. display of either p.p.i. or range-amplitude type. The loudspeaker is rotated at 3 r.p.m. A 6-in. metal corner reflector can be detected at 25 ft. Range resolution is about 6 in. and angular resolution a few degrees.

621.396.96 : 621.372.54 **149**

Filters for Detection of Small Radar Signals in Clutter.—H. Urkowitz. (*J. appl. Phys.*, Aug. 1953, Vol. 24, No. 8, pp. 1024–1031.) Signal/clutter ratio is defined as the ratio of the peak signal to the r.m.s. value of the clutter. The synthesis is studied of a linear filter with a frequency characteristic such that the signal/clutter ratio is a maximum at its output; such a filter is inserted before the second detector to improve reception of small signals. The frequency characteristic of the optimum filter is given by the conjugate of the voltage spectrum of the transmitted pulse divided by the power spectrum of the clutter. The influence of such filters on signal/noise ratio and the influence of the second detector on signal/clutter and signal/noise ratios are also discussed.

621.396.962.3 : 621.396.822 **150**

Detection of Pulse Signals in Noise.—D. G. Tucker & J. W. R. Griffiths. (*Wireless Engr*, Nov. 1953, Vol. 30, No. 11, pp. 264–273.) Methods described by previous workers are reviewed; the coherent detector, modified rectifier circuits, phase-modulation display, pulse-to-pulse integration, pulse-to-pulse correlation and optimum filtration are discussed. Visual display methods of interest apart from c.r.o. methods include the chemical recorder. For conditions where the pulse can just be detected, these methods give better results than the method of extracting the signal envelope by plain rectification.

621.396.963 : 621.314.7 **151**

Transistorized Radar Scope Display Unit.—R. S. Markowitz. (*Electronics*, Oct. 1953, Vol. 26, No. 10, pp. 182–183.) By substituting four point-contact transistors and a crystal diode for four thermionic valves, an airborne display unit has been produced having a power consumption one tenth that of the standard unit.

621.396.969 : 527 **152**

The Use of Radar for Preventing Collisions at Sea.—F. J. Wylie. (*J. Inst. Nav.*, July 1953, Vol. 6, No. 3, pp. 271–281. Discussion, pp. 281–293.) Discussion of the problem of applying the international regulations for preventing collisions at sea when one or both ships have radar equipment.

621.396.969 : 551.594.21 **153**

The Radar Detection of Dangerous Storms.—R. E. Perry. (*J. Inst. Nav.*, July 1953, Vol. 6, No. 3, pp. 238–239.) Technical data are tabulated of equipment in regular use at Entebbe airport. With an operating frequency of 9·32–9·5 kMc/s and a peak pulse power of 10 kW, moderately large thunderclouds can be detected at ranges up to about 80 miles, while larger storm formations may be detectable at ranges up to 120 miles.

621.396.969.34 **154**

New Airfield Radar Equipment.—(*Wireless World*, Nov. 1953, Vol. 59, No. 11, pp. 547–548.) Brief description of Decca Type-424 equipment, which provides most of the facilities offered by a full-scale G.C.A. The parabolic cylinder-type scanner is 14 ft across and rotates at 24 r.p.m. The magnetron generator gives a peak pulse output of 30 kW at 3·2 cm λ; pulse lengths of 0·1 and 0·5 μs are available. Maximum range is 25 miles.

MATERIALS AND SUBSIDIARY TECHNIQUES

535.215 : 546.78 **155**

The Photoemission of Tungsten in the Region of Predicted Schottky Deviations.—E. E. Buder, J. J. Ruddick & A. H. Weber. (*Phys. Rev.*, 1st Aug. 1953, Vol. 91, No. 3, pp. 561–566.) Experimental evidence has been obtained for the existence of quasi-periodic deviations of the photoemission with variation of the applied electric field, as predicted by Guth & Mullin (2766 of 1941).

535.215.1/.5 : 621.383.4 **156**

Infrared Photo-conductors.—R. A. Smith. (*Advances Phys.*, July 1953, Vol. 2, No. 7, pp. 321–369.) Work carried out, mainly since 1947, on semiconductor

research and cell development for the 1·5–10-μ range, is reviewed and discussed. The group PbS, PbTe, and PbSe is considered in detail and compared with Ge and Si. The photoconductivity of (*a*) compounds involving S, Se or Te, (*b*) intermetallic compounds, and (*c*) the elements Ge, Si, Te, Sn, Sb, is discussed and theory of the photo-effects in the PbS group of substances is presented.

535.215.5 : 537.29 **157**

Interpretation of Photoconductivity Experiments at High Field Strengths.—D. Curie. (*C. R. Acad. Sci., Paris*, 12th Oct. 1953, Vol. 237, No. 15, pp. 791–794.) Strong photocurrents observed by Kallmann & Kramer (3438 of 1952) with ZnS phosphors are discussed. The theoretical study of electroluminescence shows that, even at field strengths much lower than those causing breakdown, 'avalanches' of electrons are produced due to ionization at donor levels.

535.37 : 546.86 **158**

Research on Luminescent Antimony Oxide.—J. Janin & R. Bernard. (*C. R. Acad. Sci., Paris*, 12th Oct. 1953, Vol. 237, No. 15, pp. 798–800.) Properties of Sb_4O_5 with and without Mn are investigated.

537.226.2 **159**

The Dielectric Constant of a Liquid containing Spherical Particles.—S. H. M. El-Sabeh & J. B. Hasted. (*Proc. phys. Soc.*, 1st July 1953, Vol. 66, No. 403B, pp. 611–612.) The results of dielectric-constant determinations at wavelengths of 1·26–9·2 cm for 5% and 10% solutions of lustrex latex (a suspension of spherical particles of polystyrene in dilute soap solution) agree with Lewin's theory (2139 of 1947).

537.311.31 **160**

Increased Electrical Resistance and Thermoelectric Power due to Lacunae in Metals.—F. Abelès. (*C. R. Acad. Sci., Paris*, 12th Oct. 1953, Vol. 237, No. 15, pp. 796–798.) The changes of resistance and thermoelectric power due to lattice defects are evaluated in terms of electron moments and impurity concentrations, using a simple model according to which the metal consists of an electron gas obeying Fermi-Dirac statistics.

537.311.33 **161**

Semiconductor Statistics.—P. T. Landsberg. (*Proc. phys. Soc.*, 1st July 1953, Vol. 66, No. 403A, pp. 662–663.) The theoretical derivation of the number of electrons in impurity centres by the free-energy argument, or equivalent, is to be preferred to the approach using the Fermi-Dirac distribution function. See also 18 of 1953 and 1960 of 1953 (Guggenheim).

537.311.33 **162**

Current Carrier Mobility Ratio in Semiconductors.—L. P. Hunter. (*Phys. Rev.*, 1st Aug. 1953, Vol. 91, No. 3, pp. 579–581.) A method is proposed for measuring the ratio of electron mobility to hole mobility directly, using a single sample of either *p*- or *n*-type conductivity. The logarithm of resistivity is plotted as a function of the reciprocal of absolute temperature. The approximately linear portions of the two branches of the curve are extrapolated to their intersection. If r is the ratio of the resistivity at the intersection point to the measured resistivity at the same temperature, the quantity $[1/(r - 1) - r]$ gives the mobility ratio for *p*-type samples, and its reciprocal the corresponding ratio for *n*-type samples. With reasonable care r can be determined to within about 0·5%.

537.311.33 **163**

On the Temperature Dependence of the Mobility of Electrical Charge Carriers in Semiconductors.—E. D. Devyatkova, Yu. P. Maslakovets, L. S. Stilbans & T. S. Stavitskaya. (*C. R. Acad. Sci. U.R.S.S.*, 1st June 1952, Vol. 84, No. 4, pp. 681–682.) A new law, $u = AT^{-3}$, for the temperature dependence of the mobility u of charge carriers was found as a result of an investigation of the temperature dependence of the Hall coefficient and the conductivity of PbSe. This law applies in the region from 20 to 500°C, which is above the estimated Debye temperature of ~ −50°C. This result is not in agreement with existing theory of the interaction of electrons with the thermal vibrations of the lattice.

537.311.33 : 534.39 **164**

Modulation of the Electrical Resistivity of Germanium by a High-Frequency Stationary Acoustic Wave.—G. Mayer. (*J. Phys. Radium*, July/Sept. 1953, Vol. 14, Nos. 7/9, p. 492.) An experiment is described in which a rod of *n*-type Ge is made to vibrate in resonance with a 1·05-Mc/s quartz resonator. When d.c. is passed through the rod, the output contains a component alternating at the frequency of the vibrations. From the magnitude and phase of this signal deductions can be made regarding the variation of the number of conduction electrons with the applied pressure and the noise spectrum in semiconductors.

537.311.33 : 538.632 **165**

Diffusion Currents in the Semiconductor Hall Effect.—R. Landauer & J. Swanson. (*Phys. Rev.*, 1st Aug. 1953, Vol. 91, No. 3, pp. 555–560.) When a magnetic field is applied across a semiconductor sample, it tends to deflect all charge carriers in the same direction. Under certain circumstances a gradient in carrier concentration is set up, thus giving rise to diffusion currents, whose magnitude depends on the recombination velocity at the surface and on the lifetime of the excess carriers in the interior. Assuming small magnetic fields, formulae are derived giving the Hall coefficient in the general case. Circular and rectangular cross-sections are considered. The possibility of measuring the lifetime of excess carriers in near-intrinsic semiconductors on the basis of Hall-effect measurements alone is discussed.

537.311.33 : 546.289 **166**

***n*-Type Surface Conductivity on *p*-Type Germanium.**—W. L. Brown. (*Phys. Rev.*, 1st Aug. 1953, Vol. 91, No. 3, pp. 518–527.) A positive charge on the surface of a *p*-type Ge crystal induces a net negative space charge within the crystal adjacent to the surface. This space charge consists of ionized acceptor atoms and also, under certain conditions, of electrons. When electrons are present they provide a layer of *n*-type conductivity below the *p*-type Ge surface. Experimental evidence for the existence of such layers on the *p*-type region of some *n*-*p*-*n* transistors is presented, the layer of electrons forming an additional conducting path or channel across the *p*-type material between the two *n*-type ends. The conductance and capacitance of some channels were measured and compared with values derived from simple theory.

537.311.33 : 546.289 **167**

Evaporation of Copper from Germanium.—G. Finn. (*Phys. Rev.*, 1st Aug. 1953, Vol. 91, No. 3, pp. 754–755.) Experiments show that (*a*) the number of acceptors introduced is greater when heating takes place in a He atmosphere, and (*b*) the evaporation of Cu from a Ge specimen corresponds, within experimental error, to the loss of acceptors as given by Hall-effect measurements.

537.311.33 : 546.289 **168**

Oxygen-Induced Surface Conductivity on Germanium.—E. N. Clarke. (*Phys. Rev.*, 1st Aug. 1953, Vol. 91,

No. 3, pp. 756–757.) Experiments are described, the results of which can be interpreted in terms of the build-up of a thin oxide layer on the Ge surface.

537.311.33 : 546.289 : 535.34 : 535.61-15 **169**

Injected Absorption in Germanium.—A. F. Gibson. (*Proc. phys. Soc.*, 1st July 1953, Vol. 66, No. 403B, pp. 588–596.) The modification of infrared absorption by carrier injection was observed in *n*-type Ge crystals. The effect was investigated theoretically and experimentally as a function of wavelength, injected current, current frequency and other parameters, and good agreement was found between the basic theory and experimental results. The possible use of light beams in place of the collector and emitter contacts in a 'light triode', and the design of Ge modulators, are discussed briefly.

537.311.33 : 546.289 : 548.55 **170**

Thermally Induced Acceptors in Single Crystal Germanium.—R. A. Logan. (*Phys. Rev.*, 1st Aug. 1953, Vol. 91, No. 3, pp. 757–758.) When precautions were taken to avoid Cu contamination, rapid quenching was still accompanied by formation of acceptor centres throughout the sample, but the cause of formation was not determined.

537.311.33 : 546.289 : 621.396.822 **171**

A Simpler Explanation for the Observed Shot Effect in Germanium Filaments.—A. van der Ziel. (*J. appl. Phys.*, Aug. 1953, Vol. 24, No. 8, p. 1063.) An explanation of the effect [2035 of 1953 (Mattson & van der Ziel)] is advanced which does not conflict with Hall-effect observations on such filaments and which is based on the assumption that hole and electron traps play only a minor part. The theory is supported by experimental results.

537.311.33 : 546.46-31 **172**

The Electrical Conductivity and Thermoelectric Power of Magnesium Oxide.—R. Mansfield. (*Proc. phys. Soc.*, 1st July 1953, Vol. 66, No. 403B, pp. 612–614.) Report of measurements on sintered specimens of MgO which indicate that it is a defect semiconductor.

537.311.33 : 621.316.86 **173**

Nonlinear Semiconductor Resistors.—F. A. Schwertz & J. J. Mazenko. (*J. appl. Phys.*, Aug. 1953, Vol. 24, No. 8, pp. 1015–1024.) A phenomenological theory for the nonlinear I/V characteristic exhibited by a granular aggregate of SiC is based on the assumption that the resistance is located mainly at the grain contacts. Constants appearing in the equation derived for the characteristic have values depending on the concentration of impurities, the elastic constants and the grain shape. The validity of the equation is supported by experimental results. The theory should apply equally well to aggregates of other semiconductors over the pressure ranges in which the grains behave as elastic bodies.

537.312.8 : 669.14.018.583 **174**

The Change of Electrical Resistance of Single Crystals of Transformer Steel in a Magnetic Field.—T. D. Zotov & Ya. S. Shur. (*C. R. Acad. Sci. U.R.S.S.*, 11th Sept. 1952, Vol. 86, No. 2, pp. 267–269. In Russian.) An observed anomalous variation, of opposite sign to that usually obtained with ferromagnetic materials, can be explained on the basis of the electronic and crystallographic parameters of the material.

538.221 **175**

A Review of New Magnetic Phenomena.—R. E. Alley, Jr. (*Bell Syst. tech. J.*, Sept. 1953, Vol. 32, No. 5, pp. 1155–1172.) A simple account is given of magnetic phenomena as observed in ferrites at frequencies up to u.h.f. Domain-wall motion, dimensional resonance, ferromagnetic resonance, the Faraday effect and the effect of transverse fields on wave propagation are discussed. Applications noted include the gyrator, a one-way transmission system at u.h.f., the polarization circulator and the measurement of magnetic field strength. 28 references.

538.221 **176**

Effect of a Demagnetizing Field on Magnetic Viscosity.—R. V. Telesnin & E. F. Kuritsyna. (*C. R. Acad. Sci. U.R.S.S.*, 21st May 1952, Vol. 84, No. 3, pp. 477–478. In Russian.) Experimental results indicate that magnetic viscosity is a function of the magnetic characteristics depending on the geometry, not on the material, of the sample.

538.221 **177**

Thermal Effects accompanying Magnetization of a Ferrimagnetic Material.—L. F. Bates & N. P. R. Sherry. (*Proc. phys. Soc.*, 1st July 1953, Vol. 66, No. 403B, pp. 609–610.) The large thermal changes which occur in ferroxcube IV when taken through a hysteresis cycle are explained adequately in terms of the magnetocaloric effect of Weiss and Forrer. Domain-boundary phenomena do not appear to make a significant contribution to the energy changes.

538.221 **178**

Developments in Sintered Magnetic Materials.—J. L. Salpeter. (*J. Brit. Instn Radio Engrs*, Oct. 1953, Vol. 13, No. 10, pp. 499–575.) Reprint. See 3334 of 1953.

538.221 **179**

Ferromagnetic Domain Walls in Ferroxdure.—H. P. J. Wijn. (*Physica*, July 1953, Vol. 19, No. 7, pp. 555–564.) A study is made of the magnetic spectrum of ferroxdure samples in which the ratio of the contributions of wall displacements and domain rotations to the initial permeability is varied. Evidence is found of a resonance of domain walls.

538.221 **180**

Investigation of Ferromagnetic Resonance in a CrTe Alloy.—T. M. Perekalina. (*C. R. Acad. Sci. U.R.S.S.*, 21st May 1952, Vol. 84, No. 3, pp. 475–476. In Russian.)

538.221 **181**

Temperature Dependence of Magnetic Viscosity of Fe-Ni Alloys.—E. F. Kuritsyna. (*C. R. Acad. Sci. U.R.S.S.*, 1st June 1952, Vol. 84, No. 4, pp. 687–688. In Russian.) The relaxation times τ of wires of (*a*) invar (35% Ni), (*b*) hypernic (50% Ni) and (*c*) permalloy (78·5% Ni) were measured at temperatures from 80 to 673°K for a change in the applied field of 0·5 oersted for (*a*) and (*b*) and 0·1 oersted for (*c*). τ is approximately constant for both (*a*) and (*b*) but increases with temperature in sample (*c*). The results are discussed in relation to Telesnin's laws (2409 of 1951).

538.221 : 548.55 **182**

The Preparation in Sheet Form of Large Single Crystals of Silicon-Iron of Predetermined Orientation for Magnetic Purposes.—R. G. Martindale & D. A. Langford. (*Proc. Instn elect. Engrs*, Part II, Aug. 1953, Vol. 100, No. 76, pp. 417–426.)

538.221 : 621.3.042.14 **183**

The Assessment of Core Material Variability.—M. O. Williams. (*A.T.E. J.*, July 1953, Vol. 9, No. 3, pp. 120–133.) The meaning of complex permeability, complex reluctivity and loss parameter of ferromagnetic

cores is discussed. Statistical methods used in the assessment of core material variability are described, with examples, and their application to the determination of realistic tolerances and adjustment of design specifications is indicated.

538.221 : 621.318.2 **184**

Oxidic Permanent Magnets with Preferred Orientation.—H. Fahlenbrach. (*Elektrotech. Z., Edn A*, 1st July 1953, Vol. 74, No. 13, pp. 388–389.) A short report of investigations carried out by the author, in collaboration with W. Heister, on ceramic magnetic materials composed mainly of $BaO.6Fe_2O_3$. Results similar to those reported by Rathenau et al. (751 of 1953) were obtained.

538.221 : 669.862.5.721 **185**

Gadolinium-Magnesium Alloys with High Gadolinium Content: Preparation and Magnetic Properties.—F. Gaume-Mahn. (*C. R. Acad. Sci., Paris*, 5th Oct. 1953, Vol. 237, No. 14, pp. 702–704.)

538.222 **186**

Paramagnetic Resonance Absorption in Metals.—S. A. Altshuler, V. Ya. Kurenev & S. G. Salikhov. (*C. R. Acad. Sci. U.R.S.S.*, 1st June 1952, Vol. 84, No. 4, pp. 677–679. In Russian.)

546.23 **187**

The Supply of Selenium.—(*Beama J.*, July 1953, Vol. 60, No. 193, pp. 223–227.) Extracts from 'Review of the Technical and Economic Position of Selenium', B.E.A.I.R.A. Technical Report Z/T90, by A. M. Cassie. The supply of Se is discussed and its principal uses are considered. It is recommended that economies in the use of Se be made, particularly by using alternative materials wherever possible, and that a search for as yet untapped sources be made.

546.28 + 546.289] : 532.61 **188**

The Surface Tension of Liquid Silicon and Germanium.—P. H. Keck & W. Van Horn. (*Phys. Rev.*, 1st Aug. 1953, Vol. 91, No. 3, pp. 512–513.) Results of measurements by the drop-weight method gave 600 dynes/cm for Ge and 720 dynes/cm for Si at their freezing points.

546.28 + 546.289] : 539.32 **189**

Measurement of Elastic Constants at Low Temperatures by Means of Ultrasonic Waves — Data for Silicon and Germanium Single Crystals, and for Fused Silica.—H. J. McSkimin. (*J. appl. Phys.*, Aug. 1953, Vol. 24, No. 8, pp. 988–997.)

621.314.634 **190**

Direct-Current Characteristics of the Selenium Rectifier: Part 1 — Theory of Rectification.—M. Tomono. (*J. phys. Soc. Japan*, July/Aug. 1953, Vol. 8, No. 4, pp. 477–483.) A model of a barrier layer, consisting of a *p*-type and an *n*-type semiconductor with an intermediate insulating film, is considered in the development of a new theory of rectification which is valid over a large range of applied voltage.

621.315.612 **191**

Ceramic and Dielectric Properties of the Stannates.—W. W. Coffeen. (*J. Amer. ceram. Soc.*, 1st July 1953, Vol. 36, No. 7, pp. 207–214.) Measurements made on ceramic compounds of the stannates of Zn, Cu, Cd, Fe++, Fe+++ and Mn show that they are semiconductors. The stannates of Ba, Ca, Sr, Mg, Bi, Pb, Co and Ni were also investigated. Their dielectric constants, at 1 Mc/s, range from 12 ($SrSnO_3$) to 101 ($NiSnO_3$) and their power factors from near zero ($CaSnO_3$) to 0·0456 ($NiSnO_3$). The use of the stannates in $BaTiO_3$ bodies is discussed briefly.

621.315.612 **192**

Dielectric Bodies in the Quaternary System $BaTiO_3$–$BaSnO_3$–$SrSnO_3$–$CaSnO_3$.—W. W. Coffeen. (*J. Amer. ceram. Soc.*, 1st July 1953, Vol. 36, No. 7, pp. 215–221.) Disks of various compositions in this quaternary system containing from 3 to 60 mole % stannate were prepared and their dielectric properties were investigated. Of those containing more than 30 mole % stannate only those high in $CaSnO_3$ content were investigated, the others being too refractory for normal commercial use. The effect of stannate addition to $BaTiO_3$ was to decrease the Curie temperature and broaden the Curie peak. Dielectric constant values of $2{\cdot}3$–$2{\cdot}8 \times 10^3$ at 1 kc/s and low positive temperature coefficients up to 55°C were obtained with a 3 mole % stannate addition while a 6 mole % Ba- Sr- or $CaSnO_3$ addition gave a dielectric constant of 5–6 $\times 10^3$ at 1 kc/s between 25 and 65°C. Negative temperature coefficients were obtained with 10–60 mole % stannate additions.

621.315.612.4 **193**

Measurement of Permittivity of Mixed Barium and Strontium Titanate in 3 000-Mc/s Region.—H. Iwayanagi. (*J. phys. Soc. Japan*, July/Aug. 1953, Vol. 8, No. 4, pp. 525–530.) The permittivity was determined by observing the resonance of a sample inserted in a water-filled cavity resonator or in a waveguide window. The dependence of the permittivity on temperature (20–100°C), frequency (2·2–3·5 kMc/s), and on the relative proportions of Ba and Sr, was investigated.

621.315.612.4 : 537.228.1 **194**

Ferroelectric Properties of Some Crystals.—G. A. Smolenski. (*C. R. Acad. Sci. U.R.S.S.*, 11th Aug. 1952, Vol. 85, No. 5, pp. 985–987. In Russian.) The permittivities of $SrTiO_3$ and solid solutions of $CdTiO_3$, investigated in the region between 2°K and 300°K, exhibit maxima near 60°K; the maximum for $PbTiO_3$ occurs near 500°C. This, and the results of previous investigations (2548 of 1950 and 155 of 1952) show that piezoelectric vibrations in the solid solutions can exist over a temperature range above the Curie point, determined by the internal stresses.

621.315.612.4 : 546.431.824-31 **195**

Double Hysteresis Loop of $BaTiO_3$ at the Curie Point.—W. J. Merz. (*Phys. Rev.*, 1st Aug. 1953, Vol. 91, No. 3, pp. 513–517.) Application of an electric field to $BaTiO_3$ shifts its Curie temperature upward; hence, when an a.c. field is applied to a crystal at temperatures around the Curie temperature, the crystal becomes alternately ferroelectric and paraelectric in the course of a single cycle. The hysteresis loops observed when the crystal is in the ferroelectric state are discussed, and the results used to calculate the constants in the free-energy expression proposed by Devonshire (663 of 1950) and Slater (2188 of 1950).

621.315.612.4 : 548.55 **196**

Some Electrical Properties of Strontium Titanate.—A. Linz, Jr. (*Phys. Rev.*, 1st Aug. 1953, Vol. 91, No. 3, pp. 753–754.) Curves show (*a*) d.c. conductivity as a function of temperature, and (*b*) permittivity and loss angle as functions of temperature and frequency. The permittivity of the single-crystal specimen is 20% higher than that previously reported for sintered specimens. The activation energy deduced from conductivity is very close to that for slightly reduced TiO_2 crystals.

621.315.612.6 : 536.7 **197**

Thermodynamic and Kinetic Properties of Glasses.—R. O. Davies & G. O. Jones. (*Advances Phys.*, July 1953, Vol. 2, No. 7, pp. 370–410.)

621.315.618.015.5 : 546.226.161-1 **198**

Dielectric Breakdown of Sulphur Hexafluoride.—C. N. Works & T. W. Dakin. (*Elect. Engng, N.Y.*, July 1953, Vol. 72, No. 7, p. 624.) Summary only. Anomalies in the breakdown-voltage/electrode-spacing and the breakdown-voltage/pressure curves are discussed.

MATHEMATICS

517.512.2 **199**

Summation of Fourier Series by means of the Laplace Transformation.—P. A. Mann. (*Arch. elekt. Übertragung*, Aug. 1953, Vol. 7, No. 8, pp. 390–392.) A method is described which is particularly useful for calculating the response of a linear network to a nonsinusoidal periodic input.

517.525.2 **200**

The Chebyshev Approximation Method.—P. R. Clement. (*Quart. appl. Math.*, July 1953, Vol. 11, No. 2, pp. 167–183.) The method is presented in a form useful for physicists and engineers. Properties of Tchebycheff polynomials are discussed in detail. Applications to the theory of aerials, filters and directional couplers are indicated briefly. 31 references.

517.9 **201**

The Nature of Solutions of a Rayleigh-Type Forced-Vibration Equation with a Large Coefficient of Damping.—P. Brock. (*J. appl. Phys.*, Aug. 1953, Vol. 24, No. 8, pp. 1004–1007.) A method is described in which the forced-vibration equation is converted to a form involving a cubic function which is replaced, as an approximation, by a composite function formed of linear elements.

519 : 53 **202**

A Set of Principles to Interconnect the Solutions of Physical Systems.—G. Kron. (*J. appl. Phys.*, Aug. 1953, Vol. 24, No. 8, pp. 965–980.) Procedure is indicated for solving problems involving large and complicated physical systems by splitting the system into smaller component systems; the method avoids the necessity for solving large numbers of simultaneous equations or finding the inverse of large matrices.

MEASUREMENTS AND TEST GEAR

621.317.3 : 621.387 **203**

Neon Tube Measuring Device.—H. E. Styles. (*Wireless World*, Nov. 1953, Vol. 59, No. 11, pp. 549–552.) A simple circuit is considered comprising a high resistance R in series with a neon tube, the latter shunted by a capacitance. When a voltage (greater than a threshold value depending on the striking potential of the tube) is applied to the series combination, the tube flashes at a rate proportional to the mean current through R. The arrangement can be used for measurement of high resistance, high voltage, or leakage current at high voltage.

621.317.332 **204**

Measuring Impedance of High-Frequency Resistors.—C. L. Wellard. (*Electronics*, Oct. 1953, Vol. 26, No. 10, pp. 176–179.) Methods suitable for measurements in the frequency range 2–400 Mc/s are discussed. The unknown resistor is connected across a coaxial-type resonator tuned by a micrometer spindle, and the voltage across the resistor is detected and measured. The impedance is determined with an error $<5\%$. See also 457 of 1953 (Bady).

621.317.336.029.64 : 537.52 **205**

Methods of Measuring the Properties of Ionized Gases at High Frequencies: Part 4—A Null Method of Measuring the Discharge Admittance.—L. Gould & S. C. Brown. (*J. appl. Phys.*, Aug. 1953, Vol. 24, No. 8, pp. 1053–1056.) The admittance of a gas discharge is determined by measuring the ratio of the power transmitted through a microwave cavity to the incident power as a function of signal frequency near the resonance frequency of the cavity. Part 3: 463 of 1953.

621.317.373.029.4/.51 **206**

Phase-Angle Measurements at A.F.—R. C. Moses. (*Radio & Telev. News, Radio-Electronic Engng Section*, July 1953, Vol 50, No. 1, pp. 12–13, 21.) A precision phase-shifter, comprising an RC network in series with the circuit under test, is adjusted to give a net zero phase-shift on the c.r.o. screen. From the values of R and C the phase angle can be calculated with an error $<2\%$ in the range 20 c/s–100 kc/s. The circuit diagram, including component values, of the phase shifter is given.

621.317.4 : 538.221 **207**

Measuring Methods for some Properties of Ferroxcube Materials.—C. M. van der Burgt, M. Gevers & H. P. J. Wijn. (*Radio tech. Dig., Édn franç.*, 1953, Vol. 7, No. 3, pp. 115–135.) See 3060 of 1953.

621.317.7 : 061.4(435.3) **208**

Instruments and Equipment for the Measurement of Electrical Quantities.—W. Hunsinger. (*Z. Ver. dtsch. Ing.*, 1st July 1953, Vol. 95, No. 19, pp. 633–640.) A survey of new electrical measurement instruments shown at the 1953 Hanover Technical Fair. 132 references are given to papers on instrument design and measurement techniques.

621.317.7 : 621.372.412 **209**

A Polarity Indicator for Quartz Crystals.—H. L. Hammatt. (*Electronic Engng*, Nov. 1953, Vol. 25, No. 309, pp. 464–465.) A simple arrangement is described for testing which face of a crystal becomes positive on compression. The circuit uses two thyratrons fed through a common anode resistor, so that when one fires, on receiving a pulse from the crystal, the other is prevented from firing. The construction of a suitable crystal holder is illustrated.

621.317.7 : 621.397.2 : 621.396.822 **210**

Signal-Noise Meter Checks TV Links.—R. Moffett. (*Electronics*, Oct. 1953, Vol. 26, No. 10, pp. 164–165.) Description of portable equipment for measuring the signal/noise ratio of studio-to-transmitter links, coaxial lines, etc. The test procedure is to modulate the carrier at 60–300 c/s and to balance the signal as received against the signal after passage through an attenuator followed by an amplifier with low-frequency cut-off at 1 kc/s. Measurements on a 7-kMc/s relay path are reported.

621.317.7.029.65 : 535.417 **211**

The Fabry-Perot Interferometer at Millimetre Wavelengths.—W. Culshaw. (*Proc. phys. Soc.*, 1st July 1953, Vol. 66, No. 403B, pp. 597–608.) The design and operation of an interferometer for wavelengths around 8 mm are discussed. The reflectors are constructed from $\lambda/4$ sheets of dielectric. Extremely sharp fringes have been obtained. Measurements of dielectric constants and losses made with the interferometer are in agreement with values obtained by other methods. The possible use of the interferometer for the accurate determination of the velocity of e.m. waves, and also for length measurements, is considered briefly.

621.317.727 : 621.317.77 **212**

Oblique Coordinates and the A.C. Potentiometer.—J. E. Parton. (*Beama J.*, July 1953, Vol. 60, No. 193,

pp. 211–219.) An introduction to the application of oblique (120°) coordinates to three-phase system calculations is given. An oblique-coordinate a.c. potentiometer excited from three-phase mains and equipment for measuring the phase angles of three-phase mains voltages, are described and discussed.

621.317.729 **213**

Capacitively Coupled Field Mapper.—E. O. Gilbert & E. G. Gilbert. (*Elect. Engng, N.Y.*, July 1953, Vol. 72, No. 7, pp. 600–605.) The mapper uses resistive Teledeltos paper and a coupling capacitor. The coupling capacitor is formed by the resistive paper and a parallel coupling electrode of Al foil. A displacement current through the coupling capacitor sends a current into the paper whose distribution represents Poisson's equation. A null-type measurement circuit and probe for plotting the equipotential lines are required. Circuit problems and errors are considered in detail.

621.317.73 **214**

A Valve Megohmmeter.—M. G. Scroggie. (*Wireless World*, Nov. 1953, Vol. 59, No. 11, pp. 516–521.) A detailed description is given of an arrangement for measuring resistances up to $>10^{12}\ \Omega$. A known voltage is used to pass current through the unknown resistance in series with a known standard resistance, and the voltage drop across the latter is indicated by means of a two-valve voltmeter using cathode-follower connections.

621.317.738 **215**

Two Probe-Type [earth-] **Capacitance Meters.**—L. Medina. (*Proc. Instn Radio Engrs, Aust.*, Aug. 1953, Vol 14, No. 8, pp. 193–195.) The instruments described have a range of 50 pF and operate at ~ 2 Mc/s. The first is designed for a substitution method of measurement, a calibrated variable capacitor being incorporated in the probe; the other gives a direct reading on a calibrated moving-coil meter, and is intended for use in the mass production of electronic equipment.

621.317.75 : [621.3.018.78 + 621.396.822 **216**

A Simplified System of Wave Analysis for Production Testing.—W. P. Buuck. (*Gen. Radio Exp.*, July 1953, Vol. 28, No. 2, pp. 1–7.) A practical guide to the operation of the distortion and noise meter Type 1932-A in conjunction with a c.r.o. for rapid testing and adjustment of communication equipment.

621.317.755 : 512.99 **217**

Study of a Vectorial Analyser.—J. van Geen. (*Radio tech. Dig., Édn franç.*, 1953, Vol. 7, No. 3, pp. 137–144.) Fuller version of paper noted in 3372 of 1953.

621.317.755 : 621.316.722.029.42/.43 **218**

Oscilloscope Voltage Calibrator.—A. B. Kaufman. (*Radio & Telev. News, Radio-Electronic Engng Section*, July 1953, Vol. 50, No. 1, pp. 15–16, 31.) Details are given of a unit delivering a calibrated square-wave output of up to 50 V peak-to-peak with a 6–120-V r.m.s. input in the frequency range 1 c/s–20 kc/s. The regulator valve providing the voltage reference is operated at 105 V and the overall error is $<4\%$.

621.317.755 : 621.317.61 **219**

A Locus-Diagram Oscillograph for Audio Frequencies.—W. Dietrich. (*Funk u. Ton*, Aug. 1953, Vol. 7, No. 8, pp. 405–413.) The oscillograph, designed for operation in the range from 50 c/s to 20 kc/s, is described, and circuit diagrams, with component values, are given for the principal units. A phase-shifter circuit producing a constant shift of 90° is incorporated. Measurements on two- and four-pole networks can be made to within $\pm 4\%$, phase angles to within $\pm 5°$.

621.317.755 : 621.317.74.018.782.4 **220**

An Experimental Delay Distortion Scanner.—W. J. Albersheim. (*Bell Lab. Rec.*, July 1953, Vol. 31, No. 7, pp. 256–261.) See 2286 of 1952 (Hunt & Albersheim).

621.317.76 **221**

The Periodmeter.—R. G. Barker & G. L. Connon. (*Wireless Engr*, Nov. 1953, Vol. 30, No. 11, pp.274–275.) The instrument described measures instantaneously the period of each cycle of an input signal, and displays the information on a c.r. tube as the height of the spot above a base line, which may be offset from the screen. Pulses derived from the input signal by limiting, differentiating and delaying are used to actuate the vertical-scan generator, while a separate timebase is used for the horizontal scan. In a particular model, full-scale deflection can be obtained for a change of 60 c/s in the frequency of a signal of mean frequency 10 kc/s. The arrangement can be applied to the detection of pulse signals in noise (see 150 above).

621.385.001.4 : 534.1 **222**

Acceleration Effects on Electron Tubes.—F. W. Stubner. (*Bell Syst. tech. J.*, Sept. 1953, Vol. 32, No. 5, pp. 1203–1229.) Instruments for simulating mechanical shock and vibration and for the measurement of their effects on valves are described; accelerometers particularly are discussed. The mechanical design requirements of reliable valves are examined and several U.S.A. test reports and specifications are noted.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

534.88 : 526.956.5 : 537.528 **223**

Practical Application of the Under-Water Spark as Sound-Pulse Generator for Echo Sounding.—H. H. Rust & H. Drubba. (*Z. angew. Phys.*, July 1953, Vol. 5, No. 7, pp. 251–252.) Sparks between sintered metal blocks (10 mm × 8 mm cross-section) 0·3 mm apart were used to produce sound pulses, of duration about 1 ms, which were directed through the bottom plates of the research ship *Gauss* of the German Hydrographical Institute. An available 30-kc/s magnetostriction-type hydrophone was used to receive echoes from the sea bed. A typical echogram is given for a depth of about 35 m. For spark-produced pulses a different type of hydrophone would probably be more suitable than that actually used.

621.3.029.63/.64 : 001.891 **224**

Applications of Microwaves in Scientific Research.—H. H. Klinger. (*J. Franklin Inst.*, Aug. 1953, Vol. 256, No. 2, pp. 129–146.) An outline is given of the uses of waveguides, cavity resonators, transit-time valves, etc., in spectroscopy, biology, astrophysics, physical optics and nuclear physics.

621.38.001.8 : 786.6 **225**

Simulating Piano Tones Electronically.—L. Katz. (*Electronics*, Oct. 1953, Vol. 26, No. 10, pp. 155–157.) Description of an instrument in which phase-shift oscillators and distortion amplifiers are used to simulate the tonal effects of the piano.

621.384.622.2 **226**

The 15-Million Electron-Volt Linear Electron Accelerator for Harwell.—C. F. Bareford & M. G. Kelliher. (*Philips tech. Rev.*, July 1953, Vol. 15, No. 1, pp. 1–26.) An illustrated account of the design and construction. The corrugated waveguide is ~ 6 m long and is divided into two equal sections. A 3-kMc/s, 1·8-MW-pulse-power magnetron is used as the power source.

621.385.833 227

Focusing of High-Energy Particles by Grid Lenses: Part 2—Lens Errors.—M. Y. Bernard. (*J. Phys. Radium*, July/Sept. 1953, Vol. 14, Nos. 7/9, pp. 451–458.) Part 1: 3387 of 1953.

621.387.424 228

Measurement of the Dead Time of a G-M Counter and of the Secondary Emission from the Cathode by the Method of Delayed Coincidences.—E. Picard & A. Rogozinski. (*J. Phys. Radium*, July/Sept. 1953, Vol. 14, Nos. 7/9, pp. 445–450.)

PROPAGATION OF WAVES

621.396.11 : 535.42 229

On the Theory of Diffraction of the Electromagnetic Wave by Mountains.—K. Furutsu. (*J. phys. Soc. Japan*, July/Aug. 1953, Vol. 8, No. 4, pp. 500–524.) Equations for the field strength of the diffracted wave are derived for the case when the change in the surface curvature of the mountain is small over a distance of one wavelength. The use of vector notation simplifies the calculations. A general field-strength equation, taking into account free-space propagation and reflected or diffracted waves, is obtained.

621.396.11 : 551.5 230

Conference on Radio Meteorology.—(*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1534–1541.) Summaries are given of 61 papers for presentation at the conference at the University of Texas, November, 1953.

621.396.11 : 551.510.535 : 621.317.353 231

Alternative Developments of the Theory of Radio-Wave Interaction.—L. G. H. Huxley. (*Proc. roy. Soc. A*, 23rd July 1953, Vol. 218, No. 1135, pp. 520–536.) The new expression obtained by Crompton, Huxley & Sutton (106 above) for ΔQ, the average energy lost by an electron in a collision, is applied to the development of an alternative theory of radio-wave interaction. Application of this theory gives results in better agreement with experimental results (1220 of 1950) than is the case when the hitherto accepted expression for ΔQ is used.

621.396.11.029.45 : 551.594.6 232

A Study of Individual Radio Atmospherics Received Simultaneously at Two Places.—P. W. A. Bowe. (*Phil. Mag.*, Aug. 1953, Vol. 44, No. 355, pp. 833–840.) An extension of earlier observations (1760 of 1951) by the simultaneous recording of atmospherics at Cambridge and Aberdeen is reported. In addition to the equipment used previously, a radio direction-finder was used to locate the sources of the atmospherics. The values of the propagation factors for 1 000 km for the four frequencies studied show that the attenuation at 0·6 kc/s is less than at 3·5 kc/s. The results for 7·5 and 5 kc/s appear to indicate that attenuation is less in winter than in summer.

621.396.11.029.64 233

Oceanic Duct and its Effect on Microwave Propagation.—L. J. Anderson & E. E. Gossard. (*Nature, Lond.*, 15th Aug. 1953, Vol. 172, No. 4372, pp. 298–300.) The results of field strength measurements in the X and S microwave bands were plotted against X, a criterion for trapping, expressed in terms of meteorological parameters. Good agreement was obtained between the observed and predicted trends for field strength at wind speeds higher and lower than 15 m.p.h. and for positive and negative air-sea temperature differences.

621.396.81 234

Radio Propagation Survey.—C. B. Wooster & F. R. Tew. (*A.T.E. J.*, April 1953, Vol. 9, No. 2, pp. 74–79.) The importance of surveys as a preliminary to the establishment of a multichannel radio system is indicated. Path attenuation and its measurement are discussed. A mobile survey unit is illustrated.

621.396.81.029.5 : 621.3.012.3 235

Ground-Wave Propagation Curves for Frequencies from 150 kc/s to 10 Mc/s.—G. Millington & J. C. Thackray. (*Marconi Rev.*, 3rd Quarter 1953, Vol. 16, No. 110, pp. 109–120.) The curves given were used in revising those prepared by the C.C.I.R. Field-strength contours for different distances are shown on a logarithmic frequency scale, field strength being plotted in db relative to 1 μV/m. A set of five graphs covers five values of earth conductivity, including that for propagation over sea. The method of constructing the curves is described.

621.396.812.3.029.64 236

A Statistical Study of Selective Fading of Super-high Frequency Radio Signals.—R. L. Kaylor. (*Bell Syst. tech. J.*, Sept. 1953, Vol. 32, No. 5, pp. 1187–1202.) The results of a statistical analysis of 50 000 path-loss/frequency records, made over a period of two months, are shown graphically. Measurements were made over a 30·8-mile path, using a frequency sweep from 3·75 to 4·15 kMc/s and a single frequency of 4·19 kMc/s. The ground reflection coefficient over the path was $<0{\cdot}1$. Deep fading, caused by multipath transmission, is frequency selective; deep selective fading is ordinarily accompanied by a 6–10-db signal depression over a band of several hundred megacycles; correlation between the fading of two signals decreases with the frequency separation. Hence frequency diversity offers a practical means of avoiding fading effects if a sufficiently large frequency separation is chosen.

RECEPTION

621.376.332.029.6 237

Linear Discriminator for Ultra-high Frequencies.—H. Familier. (*Ann. Radioélect.*, July 1953, Vol. 8, No. 33, pp. 211–221.) The operation of a hybrid-T discriminator circuit for a microwave relay is analysed and the harmonic distortion introduced by an a.m. component in the klystron input is calculated. Thermal expansion of the waveguide may cause an unwanted phase shift far greater than that due to carrier-frequency instability. Methods of adjustment for distortion correction are discussed and variations of the basic discriminator circuit are reviewed.

621.396.62 : 621.396.96 238

On the Interference of Pulse Trains.—K. S. Miller & R. J. Schwarz. (*J. appl. Phys.*, Aug. 1953, Vol. 24, No. 8, pp. 1032–1036.) Problems arising from the undesired overlapping, or time coincidence, of pulses from separate pulse trains are considered. The coincidence time fraction is determined for two pulse trains with (*a*) a fixed initial phase and (*b*) a randomly varying initial phase. The coincidence time fraction is then determined for these cases if only pulse coincidences equalling or exceeding a specified interval are considered. Some problems involving more than two pulse trains are briefly discussed.

621.396.621 : 621.376.56 239

Decoding Processes for Pulse-Code Modulation.—K. Steffenhagen. (*Nachr Tech.*, July 1953, Vol. 3, No. 7, pp. 310–314.) Theory is given of decoding by means of a series arrangement of parallel RC and RLC circuits.

621.396.621 : 621.396.822 240

The Reception of Weak Amplitude-Modulated Signals with Linear Detection.—G. Fontanellaz. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st July 1953, Vol. 31, No. 7, pp. 177–181. In German.) Analyses presented by Rice (2169 of 1945 and back references) and Goldman (2007 of 1949) are applied in deriving an approximate formula for the signal/noise ratio of weak signals, in terms of carrier amplitude, modulation depth, l.f. and h.f. bandwidth, and receiver noise factor.

621.396.621 : 621.396.822 : 621.395.625.3 241

The Synchronous Magnetic Recorder and its Applications: Part 1 — Theory.—G. Suryan. (*J. Indian Inst. Sci.*, July 1953, Vol. 35, No. 3, Section A, pp. 193–203.) The problem of detecting weak signals in the presence of noise is discussed. The theory of the drum recorder is given. By rotating the drum at a frequency which is equal to or a simple fraction of the periodicity of the wanted signal, and using a long narrow pick-up head, an improved signal/noise ratio is obtained. This ratio is evaluated and the transmission characteristics of the recorder are considered. A list of applications is given.

621.396.621 : 621.396.822 : 621.395.625.3 242

The Synchronous Magnetic Recorder and its Applications: Part 2 — Experimental.—G. Suryan. (*J. Indian Inst. Sci.*, July 1953, Vol. 35, No. 3, Section A, pp. 205–214.) The design of the recorder is described and its performance is discussed and illustrated by records of nuclear resonance signals.

621.396.82.029.53 : 621.327.43 243

Radio Interference from Fluorescent Lamps in the Medium-Wave Band.—W. Brunhart, E. Rohner & L. Soós. (*Bull. schweiz. elektrotech. Ver.*, 11th July 1953, Vol. 44, No. 14, pp. 617–621. In German.) Field-strength measurements were made at 550 kc/s, 1 Mc/s and 1·4 Mc/s, of the radiation from 40-W fluorescent lamps and cold-cathode lamps supplied by six well-known manufacturers. The spatial field distribution at 550 kc/s, the relative magnitudes of receiver interference in the range 0·1–30 Mc/s (one lamp only) and the effect of lamp fittings were investigated. An attenuation of up to 20 db was obtained with lamps fitted with a metal-mesh screen.

STATIONS AND COMMUNICATION SYSTEMS

621.372.015.3 244

Typical Transients associated with Fundamental Transmission Functions.—A. Walther & J. Dörr. (*Arch. elekt. Übertragung*, Aug. 1953, Vol. 7, No. 8, pp. 379–386.) The transient response is calculated and shown graphically for pulse, step, square-wave and sine-squared signals, for fundamental transmission functions selected so that numerical values can be obtained by means of Bessel functions. Deterioration of the waveforms results from the repetition of the signals in long-distance systems, unless the phase characteristic is straightened by addition of an all-pass system. Phase-characteristic straightening can only be used to a limited extent for reducing distortion, because it gives rise to precursory signals.

621.376.018.78 : 621.396.826 245

Harmonic Distortion due to Echo Signals. Conditions for an Amplitude-Modulated Wave.—E. G. Hamer & R. G. Medhurst. (*Wireless Engr*, Nov. 1953, Vol. 30, No. 11, pp. 276–280.) Approximate formulae given previously [2890 of 1952 (Hamer)] are modified to take account of cases where either the ratio of echo to main signal is not small or the modulation depth m approaches unity. Maximum values of second-harmonic distortion occur when $m = 0{\cdot}87$, and of third-harmonic distortion when $m = 0{\cdot}91$. Comparison is made between f.m. and a.m. conditions; for f.m. exact solutions can be obtained.

621.376.3 246

A Note on the Armstrong System of Frequency Modulation.—N. N. Biswas & S. K. Chatterjee. (*J. Indian Inst. Sci.*, July 1953, Vol. 35, No. 3, Section B, pp. 119–124.) The degree of amplitude modulation produced is determined as a function of the modulating frequency and modulating voltage, using Wheeler's 'zero frequency-carrier' concept (3297 of 1941). The relation between the degree of amplitude modulation and the percentage of harmonic distortion is shown graphically.

621.376.3 : [621.395.43 + 621.396.41 247

Echo Distortion in the F.M. Transmission of Frequency-Division Multiplex.—R. G. Medhurst. (*Proc. Inst. Radio Engrs*, Oct. 1953, Vol. 41, No. 10, pp. 1520–1521.) Discussion and extension of the work reported by Albersheim & Schafer (2022 of 1952). Please note change in U.D.C. number.

621.376.3 : 621.396.41 248

Calculation of the Spectrum for Multichannel Directional Radio Links with Frequency Modulation.—G. Bosse. (*Frequenz*, Aug. 1953, Vol. 7, No. 8, pp. 239–244.) Systems in which the radio carrier is modulated by the output from a multichannel telephony system are considered. To simplify the calculation, the modulating voltage is taken as equivalent to a suitably limited Gaussian noise voltage, an approximation which improves as the number of channels increases. A general method is given for calculating the spectrum of an oscillation frequency modulated by a noise voltage, and explicit formulae are derived for the case where phase deviation is the same at all modulating frequencies. Spectral energy distribution is shown graphically for usual values of phase deviation.

621.376.5 249

Some Aspects of the Spectrum of Modulated Pulses.—V. N. Rao. (*J. Indian Inst. Sci.*, July 1953, Vol. 35, No. 3, Section B, pp. 125–136.) Fitch's method (2619 of 1948) of deriving the spectrum of modulated pulses is discussed and a modified method is described. Two distinct types of spectrum for p.f.m. and p.ph.m. systems are found, the one accompanied and the other unaccompanied by p.w.m. These are compared with the c.w. frequency and c.w. phase modulation spectra. The distortion with different methods of demodulation is examined and curves for the harmonic distortion in the case of p.w.m. are given.

621.376.54 250

Pulse Duration Modulation.—H. T. Peretko. (*Radio & Telev. News, Radio-Electronic Engng Section*, July 1953, Vol. 50, No. 1, pp. 8–11, 27.) P.w.m. characteristics are discussed, and a circuit diagram and details are given of an experimental modulator and demodulator. The pulse repetition rate is 10 000/sec and the modulation is applied to the trailing edge.

621.39 : 394.4 251

The Provision of Communications for the Coronation of Her Majesty Queen Elizabeth II.—S. M. E. Rousell, E. B. M. Beaumont & B. H. Moore. (*P.O. elect. Engrs' J.*, July 1953, Vol. 46, Part 2, pp. 71–78.) An account of the extensive network of communications set up by the Post Office to cover the organization, control, broadcasting, television and press reporting of the coronation ceremony and the associated festivities.

621.39.001.11 **252**

Information Theory.—A. M. Andrew. (*Electronic Engng*, Nov. 1953, Vol. 25, No. 309, pp. 471–475.) "The concept of information as a measurable quantity is explained and the unit of information is defined. Communication over a noisy channel is considered and Shannon's expression for the capacity of a continuous channel perturbed by white Gaussian noise is quoted and its implications discussed. The connection between information and entropy is outlined. The theory has applications in the evaluation of the efficiencies of modulation methods and in connection with nervous transmission, reaction time and sensory prosthesis."

621.39.001.11 **253**

The Application of Information Theory to Data-Transmission Systems, and the Possible Use of Binary Coding to increase Channel Capacity.—J. F. Coales. (*Proc. Instn elect. Engrs*, Part III, Sept. 1953, Vol. 100, No. 67, pp. 291–302.) Provided a small delay for coding and decoding and some loss of fine structure in the received signal can be accepted, some of the time wasted when the input signal is changing at a rate less than the maximum can be used to integrate changes in input signal over a given interval; the integrated change is then transmitted in the following interval. In this way, the bandwidth can be reduced. Alternatively, the time saved can be used for the transmission of other quantities. The number of metrons transmitted can be increased by a factor of the order of 4 for an increase of proper scale-unit of less than 50%. By limiting the total change in input signal that can be transmitted in one interval, a further saving can be effected.

621.39.001.11 **254**

On the Capacity of a Discrete Channel: Part 1.—S. Muroga. (*J. phys. Soc. Japan*, July/Aug. 1953, Vol. 8, No. 4, pp. 484–494.) An expression is derived for the capacity of a communication channel disturbed by noise. Numerical examples are given.

621.395 + 621.397.24] : 621.315.212.4 **255**

The Coaxial Cable of the New Italian Communication Network.—Monelli. (See 13.)

621.396.61/.62.029.62 : 621.376.3](436) **256**

V.H.F.-F.M. Broadcasting in Austria.—O. Koton. (*Radio Tech., Vienna*, July 1953, Vol. 29, No. 7, pp. 228–230.) Technical details of a 1-kW f.m. transmitter and superheterodyne f.m. receiver, for operation in the 88–108-Mc/s band, are given. Conventional circuits are used. A rising characteristic for the higher audio frequencies (+ 13 db at 15 kc/s) gives an improved signal/noise ratio of the radiated signal.

621.396.65 **257**

Path Testing for Microwave Radio Routes.—R. D. Campbell. (*Elect. Engng, N.Y.*, July 1953, Vol. 72, No. 7, pp. 571–577.) The effect of aerial height on received field strength is discussed and actual results are compared with calculations based on knife-edge diffraction and on smooth-earth theory. Variations in atmospheric refraction are allowed for by assuming a variable effective earth radius. C.w. test equipment for the range 3·8–4·2 kMc/s and tests made under normal propagation conditions on paths between New York and Atlantic City and between Atlantic City and New Egypt, are described and discussed. Limitations of the use of c.w. transmissions for such tests are pointed out.

621.396.932 **258**

Marine-Radio and New Commercial Radio Equipment of the Nationalized Industry.—E. Hüttmann. (*Nachr-Tech.*, July 1953, Vol. 3, No. 7, pp. 290–295.) Technical survey of marine radio equipment made in Eastern Germany.

621.396.932.029.62 **259**

Survey of the U.S.W. Harbour, Coastal and Waterways Radio Service with Special Reference to Present-Day Problems.—W. Kronjäger. (*Funk u. Ton*, Aug. 1953, Vol. 7, No. 8, pp. 419–424.)

621.398 : 621.396.712 **260**

Remote-Control System for F.M. Broadcasting.—A. V. Tidmore. (*Electronics*, Oct. 1953, Vol. 26, No. 10, pp. 138–142.) Details are given of the system in use at the WPPA transmitter at Pottsville, Pa, where the operate-control unit is located at the a.m. transmitter site 10 miles from the remotely controlled f.m. transmitter. The control operates over two telephone lines, one of which handles metering arrangements, while the other carries switching pulses and audio tones for tuning the remote transmitter.

SUBSIDIARY APPARATUS

621–526 **261**

Design Methods for Control Systems.—H. E. Weber. (*Z. angew. Math. Phys.*, 15th July 1953, Vol. 4, No. 4, pp. 233–260.) The Nyquist-diagram method of analysing feedback systems is discussed; stability problems can be simplified by using a method based on the attenuation/frequency and phase/frequency characteristics. The speed control of a d.c. motor is considered as an example.

621.311.6 : 621.387 **262**

Fast-Response High-Current Thyratron Power Supplies for Inductive Loads.—J. H. Burnett. (*Elect. Engng, N.Y.*, July 1953, Vol. 72, No. 7, pp. 627–630.) "Several methods for energizing loads such as fields of large motor generators, solenoids, magnetic clutches, and electromagnets are discussed, including the half-wave circuit with an optimum value of capacitance in parallel with the load. This method provides the fastest response for the equipment required."

621.311.8 : 621.396.65 : 621.397.2 **263**

Standby Generating Plant for the Manchester-Edinburgh Television Radio-Relay Link.—R. C. Marshman. (*P.O. elect. Engrs' J.*, July 1953, Vol. 46, Part 2, pp. 89–92.) Description of equipment, driven by an i.c. engine, which automatically restores the supply voltage at unattended relay stations in case of mains failure for more than two seconds. The sets are given daily test runs, remotely controlled from attended stations.

621.355 **264**

Electric Batteries: Recent Patents.—L. Jumau. (*Rev. gén. Élect.*, July 1953, Vol. 62, No. 7, pp. 323–334.) Discussion of improvements in Leclanché-type cells, alkaline batteries, cells with dished plates or with bipolar electrodes, HgO cells and Weston standard cells.

TELEVISION AND PHOTOTELEGRAPHY

535.65 **265**

A Determination of Subjective White under Four Conditions of Adaptation.—W. N. Sproson. (*B.B.C. Quart.*, Autumn 1953, Vol. 8, No. 3, pp. 176–192.) A detailed account is given of experiments to determine the area on the chromaticity diagram which is accepted as white by the statistical average of colour-normal observers; the results are important from the point of view of colour balance in colour-television systems. Two

methods were used, one involving a tricolorimeter with three projectors associated respectively with red, green and blue filters, and the other involving a single projector with appropriate colour filters.

621.397.2 : 621.311.8 : 621.396.65 **266**

Standby Generating Plant for the Manchester-Edinburgh Television Radio-Relay Link.—Marshman. (See 263.)

621.397.2 : 621.317.7 : 621.396.822 **267**

Signal-Noise Meter Checks TV Links.—Moffett. (See 210.)

621.397.5 **268**

16-mm Projector for Full-Storage Operation with an Iconoscope Television Camera.—E. C. Fritts. (*J. Soc. Mot. Pict. Telev. Engrs*, July 1953, Vol. 61, No. 1, pp. 45–51.) The modifications to a 16-mm projector include a faster pull-down, operating at 24 frames/sec, and a special optical system which, in combination with a rotating-disk shutter, provides adequate illumination within blanking time. Operational facilities are also described. The problem of the 24/30 frames/sec conversion is discussed.

621.397.5 **269**

1953 (Issue No. 2) S.M.P.T.E. Television Test Films: Operating Instructions.—(*J. Soc. Mot. Pict. Telev. Engrs*, July 1953, Vol. 61, No. 1, pp. 52–58.) The seven test sections are described and their use in the detection of alignment and electrical adjustment errors in receivers is discussed briefly.

621.397.5 : 535.623/.624 **270**

American Colour Television.—(*Wireless World*, Nov. 1953, Vol. 59, No. 11, pp. 524–526.) A short account of the N.T.S.C. compatible system, in which the colour signals are transmitted on a subcarrier simultaneously with the brightness signal on the main carrier, the overall channel width (including sound) being 6 Mc/s.

621.397.5(41) : 621.397.3 **271**

An Outline of the British Television System: Part 1—Generating the Picture Waveform.—D. Wray. (*P.O. elect. Engrs' J.*, July 1953, Vol. 46, Part 2, pp. 59–64.) The first of three articles. The general principles applied in the development of the picture signal are explained, the processes of scanning and synchronization are described and also the operation of a television camera. Studio equipment and procedure are noted briefly.

621.397.6 **272**

Conversion of Television Standards.—A. V. Lord. (*B.B.C. Quart.*, Summer 1953, Vol. 8, No. 2, pp. 108–124.) The principles and operation of a television standards converter are described fully, with particular reference to the equipment used at Cassel for conversion from the 819-line to the 405-line standard. See also 2469 of 1953 and 2902 of 1952.

621.397.6(436) **273**

Experimental Television Equipment at the Technische Hochschule, Vienna.—R. Just. (*Radio Tech., Vienna*, July 1953, Vol. 29, No. 7, pp. 231–234.) General description of 625-line equipment, with block diagrams of transmitter, camera and receiver.

621.397.61 **274**

Low-Level-Modulation Vision Transmitters, with Special Reference to the Kirk O'Shotts and Wenvoe Stations.—E. McP. Leyton, E. A. Nind & W. S. Percival. (*Proc. Instn elect. Engrs*, Part III, Sept. 1953, Vol. 100, No. 67, pp. 269–285. Discussion, pp. 285–290.) The questions of choice of modulation system, and electrical position of the modulated amplifier are discussed. The increase in overall efficiency obtainable, with consequent reduction in the amount of equipment required and in operating costs, led to the choice of a low-level modulation system. Calculations of valve performance are made, and the design of wide-band r.f. circuits considered. Triple-tuned coupling circuits, which give a useful increase in overall bandwidth, were selected. The construction and operation of the Kirk o'Shotts and Wenvoe transmitters, which differ only in operating frequency, are described with block and circuit diagrams. Metal rectifiers were used throughout the power-conversion equipment. See also 568 of 1953.

621.397.62 : 535.88 **275**

A Large-Screen Television Projector.—J. Haantjes & C. J. van Loon. (*Philips tech. Rev.*, July 1953, Vol. 15, No. 1, pp. 27–34.) An illustrated account of a projector designed to give pictures 3 × 4 m from a c.r.-tube image 72 × 96 mm. The c.r. tube, the optical system and the 50-kV d.c. power-supply unit are described briefly. The dissipation at the c.r.-tube screen is 25 W; air-jet cooling is used.

621.397.62 : 535.88 **276**

A Method of Increasing the Average Picture Brightness in Projection Television.—L. B. Johnson. (*Mullard tech. Commun.*, July 1953, Vol. 1, No. 4, pp. 95–103.) "By applying a form of a.g.c. in the vision channel, a considerably higher initial setting of the contrast control is permissible, resulting in a substantial increase in the average picture brightness over a complete programme."

621.397.621.2 : 621.373.43 **277**

A Direct-Drive Line-Timebase Circuit.—K. E. Martin. (*Mullard tech. Commun.*, July 1953, Vol. 1, No. 4, pp. 99–103.) A line-scan circuit for a rectangular picture tube is described. The deflection coils are connected directly in the anode circuit (190 V) of the output pentode so that only a small autotransformer for the h.v. supply is required. This supply is derived from the fly-back pulse and has an effective source impedance of 6·5 MΩ. A variable-resistance shunt across the boost capacitor provides a simple and effective width control. Constructional details and component specifications are given.

621.397.82 : 551.510.535 **278**

Interference to Television via Sporadic E on May 17, 1953.—T. W. Bennington. (*B.B.C. Quart.*, Autumn 1953, Vol. 8, No. 3, pp. 169–175.) Interference from several European stations was observed between about 1300 and 1800 G.M.T., on 45-Mc/s television and the accompanying 41·5-Mc/s sound. Contours are plotted showing the approximate distribution of sporadic E over Europe at hourly intervals from 1000 to 1900 G.M.T. on this day; these distributions account fairly well for the interference experienced. Estimates based on Slough records are given for the percentage of total time during which such interfering propagation is likely to occur.

TRANSMISSION

621.376.32 **279**

Investigations on the Serrasoid Modulator.—H. Schönfelder. (*Funk u. Ton*, July 1953, Vol. 7, No. 7, pp. 333–341.) The theory of operation is given and illustrated by experimental results. See also 1846 of 1953 (Paulsen).

621.376.32 : 621.315.612.4 **280**

Capacitor-Modulated Wide-Range F.M. System.—M. Apstein & H. H. Wieder. (*Electronics*, Oct. 1953, Vol. 26,

No. 10, pp. 190–192.) Operation of the modulator circuit described is based on the voltage dependence of a $BaTiO_3$ capacitor in the oscillator tank circuit. The capacitor is transformer-coupled to the circuit to prevent overheating of the dielectric. Frequency deviations up to 2% are obtained with carrier frequencies of 50–500 Mc/s.

621.396.61 : 621.396.712 **281**

Unattended Broadcasting Transmitters.—W. J. Morcom. (*Marconi Rev.*, 3rd Quarter 1953, Vol. 16, No. 110, pp. 134–140.) The best arrangements for reliability of service appear to be: (*a*) for high-power installations, operation of two transmitters in parallel, with automatic switching so that the loss in signal strength due to failure of one transmitter is only 3 db; (*b*) for low-power stations, operation of three transmitters in parallel with no automatic switching and a consequent power loss in the balancing resistance in the event of failure. Suitable combining networks are illustrated. Special features of transmitter design and the functions of monitoring circuits are noted.

VALVES AND THERMIONICS

621.314.632 : 546.289 **282**

Some Thermal Properties of Point-Contact Germanium Diodes.—J. R. Tillman & J. C. Henderson. (*Phil. Mag.*, July 1953, Vol. 44, No. 354, pp. 677–696.) The isothermal inverse-voltage/current characteristics of several types of point-contact Ge diodes were determined experimentally. On the assumption, the validity of which is discussed, that these characteristics can be used to determine the temperature of the barrier layer, other thermal characteristics were investigated. The results were compared with theoretical results obtained for a simple model of the diode and qualitative agreement was found. The steady-state V/I curve is in good agreement with the observed characteristic curve and this is taken as a confirmation of the view that turnover is largely the result of self-heating, as also deduced by Bennett & Hunter (1531 of 1951).

621.314.7 **283**

Transistors: Theory and Application: Part 8—Small-Signal Transistor Operation.—A. Coblenz & H. L. Owens. (*Electronics*, Oct. 1953, Vol. 26, No. 10, pp. 158–163.) Various methods of analysing transistor operation are explained and compared. Power gain and other parameters are discussed. Part 7: 3523 of 1953.

621.314.7.002.2 **284**

Production Techniques in Transistor Manufacture.—J. D. Fahnestock. (*Electronics*, Oct. 1953, Vol. 26, No. 10, pp. 130–134.) Illustrated account of processes used at the R.C.A. factory at Harrison. Temperature and timing details are given for different steps in the preparation of the Ge. A rapid method of testing barrier resistance is described.

621.383.4 : [546.817.231 + 546.817.241 **285**

Lead-Telluride and Lead-Selenide Infrared Detectors.—T. S. Moss. (*Research, Lond.*, July 1953, Vol. 6, No. 7, pp. 258–264.) The method of preparation, the construction and properties of PbSe and PbTe photoconductive cells are described.

621.385.001.4 : 534.1 **286**

Acceleration Effects on Electron Tubes.—Stubner. (See 222.)

621.385.029.6 **287**

Statistical Theory of the Magnetron (Static Condition).—G. Ya. Lyubarski & L. E. Pargamanik. (*C. R. Acad. Sci. U.R.S.S.*, 21st May 1952, Vol. 84, No. 3, pp. 491–494. In Russian.) A theory is developed by considering an electron cloud as an ideal gas in statistical equilibrium in a cylindrical magnetron with a plane anode, and the results are compared with those obtained from Hull's theory (*Phys. Rev.*, 1924, Vol. 23, p. 112). Agreement with experimental results is obtained for the electron-gas temperature and the anode characteristic of the magnetron. For small currents the state of the electron gas and the magnetron working conditions can be determined for a given external magnetic field, applied potential difference and emission current.

621.385.029.6 : 538.691 : 530.12 **288**

Relativistic Electron Trajectories in the Planar Magnetron.—F. Ollendorff. (*Elektrotech. u. Maschinenb.*, 15th May 1953, Vol. 70, No. 10, pp. 213–216.) The equations of motion of the electrons in a space-charge-free planar magnetron are developed from the Lagrangian function of relativistic mechanics, and a nonlinear differential equation of the second order is derived for the electron mass as a function of time; this equation can be solved in closed form by means of elementary functions. The electron motion depends largely on a parameter γ, which in the limiting case of small velocities can be represented as the ratio of the magnetic drift velocity to the velocity of light. Only in the case $\gamma < 1$ are electron paths of cycloid type obtained. When $\gamma > 1$ the electron paths differ completely from those typical of the classical magnetron. The various path types to be expected are shown graphically as dependent on the value of γ.

621.385.029.6 : 621.373.423 **289**

Investigation of an Interdigital Line used as Anode Circuit for an U.H.F. Magnetron Oscillator.—A. Leblond. (*Ann. Radioélect.*, July 1953, Vol. 8, No. 33, pp. 194–210.) A more detailed description is given of the construction and operation of a special interdigital structure [2187 of 1953 (Leblond et al.)]. In this a cylindrical metal wall (called a 'ceiling') lies close to the outer face of the segments so that the e.m. field developed is purely transverse. Field equations are derived from which the upper cut-off wavelength can be calculated. The dimensions of five such structures are given, with their calculated and measured wavelengths, and performance curves of a magnetron operating on 11·2-cm λ are shown.

621.385.832 : 621.395.625.3 **290**

Electron-Beam Head for Magnetic Tape Playback.—Skellett, Leveridge & Gratian. (See 11.)

MISCELLANEOUS

621.3.017.7 **291**

Temperature Prediction in Electronic Design.—P. J. Selgin & B. K. Hawes. (*Elect. Mfg*, Oct. 1952, Vol. 50, No. 4, pp. 116–119, 376, 378.) Formulae and charts are given which are useful for calculating the temperature of electronic equipment when the power dissipation is known.

621.39 : 061.4 **292**

German Radio Show.—J. E. Cope. (*Wireless World*, Oct. 1953, Vol. 59, No. 10, p. 471.) A brief note on the Düsseldorf exhibition. High-quality reproduction was a noticeable feature of the radio receivers, many of which were for f.m. Pre-production television receivers were also shown. See also *Fernmeldetech. Z.*, Oct. 1953, Vol. 6, No. 10, pp. 490–492.

621.39 : 061.4(435.3) **293**

Radio, Television and Electroacoustic Engineering.—W. Althans. (*Z. Ver. dtsch. Ing.*, 1st July 1953, Vol. 95, No. 19, pp. 641–646.) A survey of new apparatus shown at the 1953 Hanover Technical Fair. 94 references.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.21-13 294

Finite-Amplitude Sound Waves.—J. B. Keller. (*J. acoust. Soc. Amer.*, March 1953, Vol. 25, No. 2, pp. 212–216.) Exact solutions of the one-dimensional gas dynamic equations, representing periodic sound waves of finite amplitude, are obtained for a particular medium. The progressive wave from a vibrating piston and the standing wave in a closed tube are examined in detail.

534.213.4-13 295

The Theory of the Propagation of Plane Sound Waves in Tubes.—D. E. Weston. (*Proc. phys. Soc.*, 1st Aug. 1953, Vol. 66, No. 404B, pp. 695–709.) Propagation in gases within cylindrical tubes of widely differing diameters is considered. The phase velocity, attenuation and cross-section profile of particle velocity are investigated theoretically and their interrelation pointed out. The factors affecting the validity of Kirchhoff's formulae are considered and the theory is applied to Lawley's experimental results (2408 of 1952).

534.222.1 296

A Particular Case of the Propagation of Sound in an Anisotropic Medium.—L. M. Brekhovskikh. (*C. R. Acad. Sci. U.R.S.S.*, 11th Dec. 1952, Vol. 87, No. 5, pp. 715–718. In Russian.) A theoretical treatment of the case when the velocity of sound in the direction of the z coordinate is given by $c = c_0$ for $0 < z < h$ and $c = c_0 [1 + 2a(z - h)]^{-\frac{1}{2}}$ for $h < z < \infty$.

534.232 297

Transient Loading of a Baffled Strip.—J. W. Miles. (*J. acoust. Soc. Amer.*, March 1953, Vol. 25, No. 2, pp. 204–205.) The relation between the applied force and the resultant velocity variation is investigated for a plate mounted in an infinite baffle.

534.232 : 621.395.623.7 298

Transient Loading of a Baffled Piston.—J. W. Miles. (*J. acoust. Soc. Amer.*, March 1953, Vol. 25, No. 2, pp. 200–203.) The relation between the applied force and the resultant velocity variation of a circular piston is investigated using the Laplace transform. The results indicate that a loudspeaker system designed for critical damping in the steady state will be slightly overdamped in its initial motion, i.e. for about 10^{-3} sec.

534.26 299

Diffraction of Sound Waves by a Circular Aperture.—G. Bekefi. (*J. acoust. Soc. Amer.*, March 1953, Vol. 25, No. 2, pp. 205–211.) Measurements of the pressure in the aperture and in the near field, using a wavelength of about 3 cm and apertures of diameter 5λ–10λ, are reported and discussed. A new formula, which represents conditions in the field more accurately than Kirchhoff's formula, is derived theoretically.

534.321.9 + 535 300

Recent Developments in Ultrasonics and Optics.—(*Nature, Lond.*, 5th Sept. 1953, Vol. 172, No. 4375, pp. 443–444.) Summaries of papers read at the Summer Provincial Meeting of the Physical Society.

534.612.4 301

Comparison of Microphone Calibrations using Pure Tones or using a Noise Source.—P. Chavasse & L. Pimonow. (*Ann. Télécommun.*, Aug./Sept. 1953, Vol. 8, Nos. 8/9, pp. 267–270.) Microphone response curves obtained by use of pure tones and by use of white noise are reproduced and discussed. If the microphone curve obtained with pure tones is flat, or nearly so, the response to white noise, using an analyser for which $\Delta f/f$ is constant, will rise towards the higher frequencies. Apart from this difference, the response curves obtained by the two methods are very similar. It appears to be absolutely necessary to determine, for any measurement microphone, both the distortion and the maximum sound pressure that may be applied to it.

534.64 302

The Acoustic Waveguide: Part 1 — An Apparatus for the Measurement of Acoustic Impedance using Plane Waves and Higher-Order-Mode Waves in Tubes.—E. A. G. Shaw. (*J. acoust. Soc. Amer.*, March 1953, Vol. 25, No. 2, pp. 224–230.) Apparatus operating in the frequency range 1–3 kc/s is described. See also 2537 of 1953.

534.64 **303**

The Acoustic Waveguide: Part 2 — Some Specific Normal Acoustic Impedance Measurements of Typical Porous Surfaces with respect to Normally and Obliquely Incident Waves.—E. A. G. Shaw. (*J. acoust. Soc. Amer.*, March 1953, Vol. 25, No. 2, pp. 231–235.) Techniques described in part 1 (302 above) were used for measurements on rock-wool, hair-felt and acoustic tile backed by a rigid wall.

534.75 **304**

Effect of Different Types of Electrodes in Electrophonic Hearing.—G. Flottorp. (*J. acoust. Soc. Amer.*, March 1953, Vol. 25, No. 2, pp. 236–245.)

534.79 **305**

The Variation of Modulation Thresholds by Masking Tones and Noises.—E. Zwicker. (*Akust. Beihefte*, 1953, No. 2, pp. 274–278. In German.) Experiments on a subject with average hearing are reported. Masking tends to raise the threshold of audibility for sound and for modulation of sounds at levels of intensity within 30 db above the new threshold. For sounds at higher intensity levels the modulation threshold is unaffected by masking.

534.833 : 532.13 : 534.321.9 **306**

Viscosity as a Factor in the Anomalous Absorption of Ultrasonic Waves in Liquids.—S. Parthasarathy & A. F. Chhapgar. (*Ann. Phys., Lpz.*, 2nd July 1953, Vol. 12, Nos. 4/6, pp. 316–320. In English.) The loss in the oscillating quartz crystal, due to internal friction and radiation of energy to the surrounding medium, was found to be proportional to $\eta^{\frac{1}{2}}$, where η is the coefficient of viscosity.

534.833.1 **307**

Notes on the Transmission of Sound through Plates.—R. D. Fay. (*J. acoust. Soc. Amer.*, March 1953, Vol. 25, No. 2, pp. 220–223.) A formula that can be readily evaluated is derived for the transmittivity of steel plates immersed in a fluid. Discrepancies between values calculated from the formula and observed values indicate that losses associated with shear waves in steel are not negligible.

534.834 **308**

Measurement of Sound Propagation in Liquid-Filled Pipes having Zero-Impedance Walls.—W. Kuhl & K. Tamm. (*Akust. Beihefte*, 1953, No. 2, pp. 303–316. In German.) Suppression of sound in pipes with a circular, a subdivided circular, or a rectangular cross-section, can be realized by means of a cellular rubber lining. Good agreement with theoretically predicted results is obtained.

534.834 **309**

Theory of Sound Attenuation in Ducts of Rectangular Cross-Section with one Absorbent Wall, and the Resulting Maximum Attenuation Factor.—L. Cremer. (*Akust. Beihefte*, 1953, No. 2, pp. 249–263. In German.) Charts are presented from which the attenuation constant can be read off directly at any one of five frequencies. These are derived from the Morse diagram noted in 680 of 1940. For a report of experimental work see 310 below.

534.834 **310**

Experimental Investigations for the Realization of the Maximum Theoretically Attainable Sound Attenuation in a Rectangular Air Duct with Absorbent Walls.—O. Gerber. (*Akust. Beihefte;* 1953, No. 2, pp. 264–270. In German.) Using a specially designed single absorption wall, attenuations up to 170–200 db/m were obtained at certain frequencies in a rectangular air duct 5 cm wide. The average attenuation over a wide frequency band was ~ 60 db/m. Experimental details are given. The application of the results to air ventilation ducts and similar systems is noted.

534.84 **311**

Directional Distribution and Time Sequence of Sound Reflections in Rooms.—R. Thiele. (*Akust. Beihefte*, 1953, No. 2, pp. 291–302. In German.) The results are reported of comprehensive experiments performed in broadcast studios, theatres and a church, using a fixed omnidirectional sound radiator, and a directional microphone at various points. A formula is given for the 'directional diffusion', which is found from the microphone reception pattern, and has the value 100% for uniform omnidirectional reception; actual values found ranged between 13% and 66%. Oscillograms of short pulses and echoes are shown. The 'definition' of the sound at the microphone was calculated from the ratio between the energy received in the first 50 ms and the total energy received; values between 10% and 90% were found, the latter corresponding to a high intelligibility of speech.

534.846 **312**

The Acoustics of the Royal Festival Hall, London.—P. H. Parkin, W. A. Allen, H. J. Purkis & W. E. Scholes. (*J. acoust. Soc. Amer.*, March 1953, Vol. 25, No. 2, pp. 246–259.) Shortened version of paper noted in 2198 of 1953.

534.851 : 621.317.35 : 621.3.018.78 **313**

Distortion in Phonograph Reproduction.—H. E. Roys. (*RCA Rev.*, Sept. 1953, Vol. 14, No. 3, pp. 397–412.) Reprint. See 2736 of 1953.

621.395.61 **314**

Microphone Sensitivity Conversion.—L. Rosenman. (*Electronics*, Nov. 1953, Vol. 26, No. 11, p. 194.) A chart gives the relation between the values of microphone sensitivity rated according to three different commonly used methods.

621.395.61 : 546.431.824-31 **315**

Broad-Band Directional Barium-Titanate Transducers.—L. Camp. (*J. acoust. Soc. Amer.*, March 1953, Vol. 25, No. 2, pp. 297–301.) Transducers suitable for underwater operation, and having desired directional characteristics, are constructed from arrays of short thin-walled $BaTiO_3$ tubes in a fluid medium.

621.395.61 : 621.395.623.7 **316**

Loudspeaker-Microphones.—H. Gemperle. (*Elektrotech. Z., Edn B*, 21st Aug. 1953, Vol. 5, No. 8, pp. 259–263.) A discussion of the conditions to be satisfied to obtain an electroacoustic transducer operating efficiently in either direction.

621.395.616 **317**

The Sensitivity Limits for a Capacitor Microphone in a Low-Frequency Circuit.—H. Grosskopf. (*Akust. Beihefte*, 1953, No. 2, pp. 279–290. In German.) General relations are derived for the sensitivity of a microphone the dimensions of which are small compared with the wavelength of the highest frequency. The transmission coefficient of the microphone and the noise component of the amplifier input circuit are considered separately. An equivalent circuit-noise level of 10 phon can be attained with a uniform response over the a.f. range.

621.395.616 **318**

New High-Grade Condenser Microphones.—F. W. O. Bauch. (*J. audio Engng Soc.*, July 1953, Vol. 1, No. 3, pp. 232–240.) Reprint. See 1230 of 1953.

621.395.616 : 534.6 **319**

A Capacitive Velocity Pickup for Vibrations of Structures.—K. Tamm & E. Aha. (*Akust. Beihefte*, 1953, No. 2,

pp. 270–273. In German.) A pickup with a frequency response level between 20 c/s and 2 kc/s is described. When used in a bridge circuit, operating with a 10-V 1·8-Mc/s input, the velocity sensitivity is 3 V/(m/sec).

621.395.616 : 534.612.2 **320**

Microphones measure High-Intensity Sound.—J. K. Hilliard. (*Electronics*, Nov. 1953, Vol. 26, No. 11, pp. 160–163.) Three different types of capacitor microphone are discussed, suitable for measurement of sound levels in the range 40–220 db referred to 0·0002 dyne/cm². A pistonphone for calibration is described and applications to investigations of industrial, explosion and jet noise are indicated.

621.395.623.75 **321**

An Investigation of the Air Chamber of Horn-Type Loudspeakers.—B. H. Smith. (*J. acoust. Soc. Amer.*, March 1953, Vol. 25, No. 2, pp. 305–312.) A boundary-value treatment leads to the solution of the wave equation for the general case in which the horn throat enters the air chamber in any rotationally symmetrical manner. Special cases are analysed. Design methods for eliminating undesired higher-order modes are discussed.

621.395.625.3 **322**

The Development of a Variable Time Delay.—K. W. Goff. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, pp. 1578–1584.) A magnetic-drum system for acoustic studies amenable to correlation techniques is discussed. Two recording and reproducing channels are provided by using two tracks: the time difference between them can be varied from — 15 ms to + 190 ms by shifting one of the recording heads. Uniformity of the layer of magnetic material is obtained by spraying the drum with a dispersion of iron oxide. The dependence of the performance on the spacing between the head and the magnetic material is analysed. A flutter-free mechanical drive system is described.

621.395.625.3 **323**

Structure and Performance of Magnetic Transducer Heads.—O. Kornei. (*J. audio Engng Soc.*, July 1953, Vol. 1, No. 3, pp. 225–231.) The influence of various structural features and properties of the materials usedon the performance of ring heads is discussed; a particular commercially available head is described.

621.395.625.3 **324**

Studies on Magnetic Recording: Part 3 — The Recording Process. Part 4 — Calculation of the Fields in and around the Tape.—W. K. Westmijze. (*Philips Res. Rep.*, Aug. 1953, Vol. 8, No. 4, pp. 245–269.) Biasing methods and the longitudinal and transverse magnetization of tape are discussed from the experimental and theoretical points of view. Part 2: 9 of January.

621.395.92 **325**

An Electronic Hearing Aid.—P. Blom. (*Philips tech. Rev.*, Aug. 1953, Vol. 15, No. 2, pp. 37–48.) Details are given of a range of models permitting adaptation for various types of hearing defect. A piezoelectric-crystal microphone is used, with the alternative of switching to a pickup coil for direct induction e.g., from a telephone receiver. Automatic volume compression at seven different levels is available. Either a magnetic or a crystal-type earphone is used.

AERIALS AND TRANSMISSION LINES

621.372 **326**

Recent Research on the Transmission of Signals along Metal and Dielectric Lines.—H. Kaden. (*Fernmeldetech. Z.*, Sept. 1953, Vol. 6, No. 9, pp. 432–438.) Theory of propagation along metal and dielectric waveguides and wires is reviewed. Measurements made at λ 12 cm on a 70-m line comprising copper helices with a pitch of 2 cm indicate marked dependence of attenuation on conditions of rain and hail, due to the formation of a nonuniform surface and consequent radiation of energy. See also 908 and 1893 of 1952.

621.372.22 : 621.372.51 **327**

The Hyperbolic Transmission Line as a Matching Section.—H. J. Scott. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, pp. 1654–1657.) Coaxial-line sections in which the variation of characteristic impedance along the section is represented by a hyperbolic function are relatively insensitive to variations of frequency. The performance of such lines is described in terms of reflection coefficients. Two types are considered; in the one, the characteristic impedance varies as a hyperbolic tangent, in the other the reflection per unit length varies as the square of a hyperbolic secant.

621.372.8 **328**

Propagation of Microwaves through a Cylindrical Metallic Guide Filled Coaxially with Two Different Dielectrics.—S. K. Chatterjee. (*J. Indian Inst. Sci.*, Section B, Jan. 1953, Vol. 35, No. 1, pp. 1–16.) The field components for the TE_{01} modes are derived from Maxwell's equations; the attenuation constant for this mode is then calculated, using the Poynting vector.

621.372.8 **329**

Modification of the Electrical Field Strength in a Rectangular Waveguide excited in the Fundamental H_{10} Mode due to the Introduction of a Current-Carrying Thin Circular Wire.—R. Müller. (*Arch. elekt. Übertragung*, Sept. 1953, Vol. 7, No. 9, pp. 451–457.) The field strength is given by an infinite series involving Hankel functions corresponding to the series of superposed interfering cylindrical waves reradiated by the wire; all but one of these decay very rapidly. The single reradiated wave remaining at a little distance from the wire is of the same type as the primary wave, on which it is superposed. Hence line theory is applicable outside the limited interference region.

621.372.8 **330**

Matching Nonstandard Waveguide Sections.—A. Chlavin. (*Electronics*, Nov. 1953, Vol. 26, No. 11, pp. 192–193.) An experimental procedure is described for designing junctions between waveguides of different types.

621.396.67 **331**

Excitation Coefficients and Beamwidths of Tschebyscheff Arrays.—R. J. Stegen. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, pp. 1671–1674.) Exact expressions are obtained for the excitation coefficients of a Tchebycheff array by equating the array space factor to a Fourier series whose coefficients are readily calculated. Curves are presented showing the variation of half-power beam width with aerial length for various side-lobe levels. An expression for beam width is derived which is exact for small values of beam width.

621.396.674.3 **332**

Radiation from a Vertical Electric Dipole over a Stratified Ground.—J. R. Wait. (*Trans. Inst. Radio Engrs*, July 1953, Vol. AP-1, No. 1, pp. 9–11.) Expressions are derived for the radiation fields at low frequencies. An 'effective numerical distance' is defined, by means of which numerical data for homogeneous ground can be applied to ground-wave propagation over plane ground with any number of parallel stratifications.

621.396.677.3.029.62 : 523.854.22 : 621.396.822 **333**

The Distribution of the Discrete Sources of Cosmic Radio Radiation.—B. Y. Mills. (*Aust. J. sci. Res., Ser. A*, June 1952, Vol. 5, No. 2, pp. 266–287.) The outputs from two coplanar 101-Mc/s beam aerials, 60 m or 270 m apart, were combined and recorded, the output of one aerial being reversed at 25 c/s. The aerials, each of which consisted of 24 end-fed half-wave dipoles and a similarly constructed reflector, could be tilted about an *E-W* horizontal axis. 77 sources were observed and recorded.

621.396.677.71 **334**

Traveling-Wave Slot Antennas.—J. N. Hines, V. H. Rumsey & C. H. Walter. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, pp. 1624–1631.) The travelling-wave slot aerial may be considered as an array of $\lambda/2$ slot aerials, but is sometimes easier to design and construct than such an array. Four types are distinguished according to the mode of the wave propagated; two of these are hybrid types, giving end-fire operation. Measured propagation constants for aerials of various shapes are shown graphically. Control of radiation pattern by variation of the slot width along the aerial is discussed. A design technique is described by means of which the pattern can be predicted exactly from measurements of individually excited array elements.

621.396.677.833.2.029.64 **335**

A New Wide-Angle Microwave Reflector.—K. S. Kelleher. (*Tele-Tech*, June 1953, Vol. 12, No. 6, pp. 98–99 . . 169.) The characteristics and the applications of an X-band wide-angle and a medium-angle parabolic torus reflector are compared with those of the paraboloid type. The applications include simultaneous reflection of a number of beams for controlling a number of remote stations, and a marine-navigation radar scanner.

621.396.677.85 **336**

A Two-Dimensional Microwave Luneberg Lens.—G. D. M. Peeler & D. H. Archer. (*Trans. Inst. Radio Engrs*, July 1953, Vol. AP-1, No. 1, pp. 12–23.) Detailed description of the design and performance of a lens aerial for radar scanning. Design is based on TE_{10}-mode propagation by nearly parallel plates. The space between two conducting plates, of diameter 36 in., is filled with polystyrene, the thickness of which varies with the normalized radius, r, to give the desired refractive index $n = \sqrt{2 - r^2}$. The lens maintains constant gain and beam shape throughout the scan, with side-lobe level at least 18 db below peak power. A 360° scan can be effected using peripheral flares on the plates. The stacking of lenses to concentrate the beam is investigated.

AUTOMATIC COMPUTERS

681.142 **337**

Application Factors for Electrical Resolvers.—S. Davis. (*Elect. Mfg*, March 1953, Vol. 51, No. 3, pp. 128–133 . . 328.) The device described resembles a small motor and was originally designed for solving trigonometry problems in conjunction with analogue computers. Possible applications for control purposes in industry are discussed.

681.142 **338**

Magnetic Drum Design.—D. G. O'Connor. (*Electronics*, Nov. 1953, Vol. 26, No. 11, p. 196.) A chart relates the various parameters involved.

681.142 **339**

Step-Switch Converter Digitizes Analog Data.—R. R. Bennett & H. Low. (*Electronics*, Nov. 1953, Vol. 26, No. 11, pp. 164–165.)

CIRCUITS AND CIRCUIT ELEMENTS

621.314.2 **340**

Review of New Materials and Techniques in High-Fidelity Transformer Design.—L. W. Howard. (*J. audio Engng Soc.*, July 1953, Vol. 1, No. 3, pp. 265–267.)

621.314.7 : 621.375.4 **341**

Transistors: Theory and Application: Part 9—Grounded Emitter and Collector Circuits.—A. Coblenz & H. L. Owens. (*Electronics*, Nov. 1953, Vol. 26, No. 11, pp. 166–172.) Formulae and typical values of parameters are tabulated for various circuit arrangements for junction and point-contact transistors. Part 8: 283 of January.

621.314.7 : 621.375.4.015.3 **342**

Transient Analysis of Transistor Amplifiers.—W. F. Chow & J. J. Suran. (*Electronics*, Nov. 1953, Vol. 26, No. 11, pp. 189–191.) See 3513 of 1953.

621.316.86 : [537.311.32 + 621.396.822 **343**

The Electrical Conductivity and Current Noise of Carbon Resistors.—I. M. Templeton & D. K. C. MacDonald. (*Proc. phys. Soc.*, 1st Aug. 1953, Vol. 66, No. 404B, pp. 680–687.) The variation of resistance with temperature, pressure, and magnetic field in several types of carbon resistor was measured down to liquid-He temperatures. The dependence of the noise spectrum on the current intensity, temperature and magnetic field was also investigated; the $1/f$ law holds at all temperatures.

621.316.923 **344**

Basic Fuse Types for Electronic Equipment.—E. V. Sundt & A. J. Steele. (*Elect. Mfg*, April 1953, Vol. 51, No. 4, pp. 144–146, 366.) Types with slow, medium and fast action are described.

621.318.4 : 621.318.134 **345**

Tolerances and Temperature Coefficient of Coils with Ferroxcube Slugs.—H. van Suchtelen. (*Electronic Applic. Bull.*, Jan./Feb. 1953, Vol. 14, Nos. 1/2, pp. 27–32.) Extension of a previous discussion (939 of 1953). From the point of view of insensitivity to variations of core permeability and of temperature, the closed core with air-gap is best, the rod core with long coil next, and the rod core with short coil worst. See also 3636 of 1953.

621.318.42 **346**

A Variable Inductor.—R. E. Allison. (*J. audio Engng Soc.*, July 1953, Vol. 1, No. 3, pp. 262–264.) An a.f. inductor is described in which core hysteresis effects are eliminated, the inductance being controlled by moving a magnet in relation to the cores. Q values > 100 at 1 kc/s and > 30 at 100 c/s are possible. Experimental filters using the inductors are also described.

621.318.5 **347**

Current Trends in Miniature Relay Design.—I. S. Mayer. (*Elect. Mfg*, Feb. 1953, Vol. 51, No. 2, pp. 135–137 . . 364.) Design of relays for airborne electronic equipment is discussed.

621.318.572 **348**

The Optimum D.C. Design of Flip-Flops.—D. K. Ritchie. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, pp. 1614–1617.) A simple criterion is derived by means of which it can immediately be seen whether or not a flip-flop circuit corresponding to specified requirements is realizable. A numerical example is given.

621.318.572 : 621.385.832 **349**

The E1T Decade Counter Tube.—(See 603.)

621.318.572 : 621.387 350

Polycathode Counter-Tube Applications.—J. H. L. McAuslan & K. J. Brimley. (*Electronics*, Nov. 1953, Vol. 26, No. 11, pp. 138–141.) The use of dekatrons in millisecond timers, batching counters and c.r.o. time markers is described. The basic decade units are capable of counting up to 20 000 per sec. See also 3485 of 1952 and 771 of 1953 (McAuslan).

621.372 351

A Method of Approximate Steady-State Analysis for Non-Linear Networks.—G. R. Slemon. (*Proc. Instn elect. Engrs*, Part I, Sept. 1953, Vol. 100, No. 125, pp. 275–287.) Approximate solutions for the fundamental and third harmonic are obtained by a three-stage method involving (*a*) a first approximation to the fundamental-frequency solution, usually accurate to within 10%, (*b*) a third-harmonic solution (generally within 15%) using an equivalent circuit which is dependent on the first fundamental solution, (*c*) a correction to the fundamental solution, using third-harmonic quantities, which brings its accuracy to within about 3%. Adaptations of some standard techniques of solving linear steady-state problems for use with this method of analysis are described. Appendix by G. H. Rawcliffe.

621.372.41 : 621.396.822 352

Effective Circuit Bandwidth for Noise with a Power-Law Spectrum.—P. R. Karr. (*J. Res. nat. Bur. Stand.*, Aug. 1953, Vol. 51, No. 2, pp. 93–94.) Analysis is developed for a tuned *RLC* circuit, for noise with a frequency spectrum given by an arbitrary power law. The effective bandwidth is presented in terms of that for white noise.

621.372.412 353

The Piezoelectric Oscillations of a Quartz Crystal at its Odd, Even and Half-Odd Harmonics.—S. Parthasarathy, M. Pancholy & A. F. Chhapgar. (*Ann. Phys., Lpz.*, 16th April 1953, Vol. 12, Nos. 1/3, pp. 1–7. In English.) The results reported in *J. sci. industr. Res.*, 1944, were confirmed by observing the diffraction patterns of the oscillating quartz. See also 1619 of 1953.

621.372.412 : 621.373.421.13.029.4 354

Flexure Mode Quartz Oscillators.—N. J. Beane & R. C. Richards. (*Marconi Rev.*, 4th Quarter 1953, Vol. 16, No. 111, pp. 141–168.) Details are given of the modes of motion, electrode arrangements and electrical performance of the duplex, *XY* and *NT* types. Typical frequency/temperature curves and graphs of other crystal characteristics are shown. A crystal-controlled a.f. oscillator is described and the circuit diagram, including component values, is given.

621.372.5.012.029.6 355

Loci-Curve Theory applied to High-Frequency Networks.—E. Schelisch. (*Marconi Rev.*, 4th Quarter 1953, Vol. 16, No. 111, pp. 169–183.) The application of the method is shown for the evaluation of such response curves of four-terminal networks as are produced by the variation of one parameter. Examples are given of the calculation of (*a*) a wide-band thermistor mount, using a rectangular admittance chart, and (*b*) the variation of the input reflection coefficient with frequency of a given transformer, using a Smith chart.

621.372.51.012.3 : 621.396.67 356

Antenna-Matching Network Efficiency.—R. L. Tanner. (*Electronics*, Nov. 1953, Vol. 26, No. 11, pp. 142–143.) Charts are presented for estimating the transfer efficiency of matching networks.

621.372.54 357

Conformal Mappings for Filter Transfer Function Synthesis.—G. L. Matthaei. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, pp. 1658–1664.) Conformal mapping provides a practical way of solving the e.s.-potential problems previously considered (1611 of 1953). Analysis in the mapped plane also yields convenient methods for predetermining the number of poles and zeros required to meet given design specifications.

621.372.54 358

Theory of Maximally Flat and Quasi-Tchebycheff Filters.—F. S. Atiya. (*Arch. elekt. Übertragung*, Sept. 1953, Vol. 7, No. 9, pp. 441–450.) The synthesis of a quadripole with a prescribed attenuation function is described. This function has to satisfy certain conditions. The synthesis is carried out for maximally flat and quasi-Tchebycheff low-pass filters, the results being presented in curves suitable for calculating the values of the circuit components. The treatment is extended to band-pass filters by means of a well-known frequency transformation.

621.372.54 359

***RLC* Lattice Networks.**—L. Weinberg. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, p. 1667.) Correction to paper noted in 3535 of 1953.

621.372.543.2 360

Band-Pass Filters.—F. S. Atiya. (*Wireless Engr*, Dec. 1953, Vol. 30, No. 12, pp. 307–311.) A method is presented for synthesizing constant-resistance networks to have maximally flat or Tchebycheff-type response characteristics. A numerical example of each type is calculated.

621.372.543.2 : 621.397.61 361

High-Frequency-Filter Problems in Television Transmitters.—W. Burkhardtsmaier. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 7/8, pp. 150–154.) Coaxial-line filters for the partial suppression of the lower sideband are discussed. Particular attention is paid to arrangements suitable for high-level modulation, in which the filter is spatially separated from the output stage and its input impedance is maintained constant over the frequency band.

621.373.4 : 621.316.726 362

Electrical Control of Valve-Transmitter Frequency by means of an Electrodeless Gas Discharge.—B. Koch. (*Z. angew. Phys.*, Aug. 1953, Vol. 5, No. 8, pp. 292–294.) The tuned-circuit inductor of an oscillator was wound round an argon-filled cylindrical container, in which an electrodeless discharge could be maintained. The oscillator frequency was nearly linearly proportional to the anode voltage and was also dependent on the gas pressure. See also 90 of January (Koch & Neuert).

621.373.4 : 621.396.822 363

Noise Properties of *LC* Oscillators.—J. van Slooten. (*Electronic Applic. Bull.*, March/April 1953, Vol. 14, Nos. 3/4, pp. 33–39.) Previous analyses based on the concepts of (*a*) forced oscillations [362 of 1953 (Lerner)] and (*b*) disturbed free oscillations (2940 of 1953) are discussed; the extent of the a.m. and the f.m. resulting from the presence of noise is examined.

621.373.421 364

Pseudoresonant and Phase-Shifting Quadripoles as Frequency-Determining Elements in *RC* Oscillators.—R. Hennicke. (*Nachr Tech.*, Aug. 1953, Vol. 3, No. 8, pp. 354–358.) *RC* oscillators with a sinusoidal output are divided into two main groups, according to the type of *RC* network they include. Equivalent circuits are obtained and simple expressions are derived for the frequency of stable oscillation and for the condition for self-excitation.

621.373.421.1 : 621.385.3 **365**

Theory of Triode Oscillators with Coaxial Resonators.—E. Hauri. (*Bull. schweiz. elektrotech. Ver.*, 22nd Aug. 1953, Vol. 44, No. 17, pp. 761–768.) A study of disk-seal-triode oscillators. The conditions necessary for maintaining oscillations are derived. The width of the frequency range with a fixed-tuned grid circuit is calculated from the valve parameters; deviations from the theoretical value encountered under working conditions are discussed. A general criterion for mode separation is established. 35 references.

621.373.43 **366**

Pulse Generator with Variable Repetition Frequency and Pulse Width.—H. Spalding & W. Vogt. (*Fernmeldetech. Z.*, Sept. 1953, Vol. 6, No. 9, pp. 428–431.) An instrument designed around the EQ40 nonode valve is described; the principle of operation is that of the 'ϕ-detector' [505 of 1950 (Jonker & van Overbeek)]. The pulse-repetition frequency can be varied between 50/sec and 20 000/sec (or higher), the duty factor from 0 to 50%, and the amplitude from 0 to 100 V. The pulse flank occupies $< 0{\cdot}2\%$ of the pulse period. P.a.m., p.w.m. and p.ph.m. can be used. A complete circuit diagram, including component values, is given.

621.375.2 : 621.385.15 **367**

Wide-Band Amplifiers using Secondary-Emission Tubes.—C. H. Chandler & G. D. Linz. (*RCA Rev.*, Sept. 1953, Vol. 14, No. 3, pp. 367–378.) The applications of an experimental valve, particularly at v.h.f., in r.f. or i.f. amplifiers, c.r.-tube deflection amplifiers and distributed amplifiers are described and discussed. The transconductance of this valve is 15mA/V, the input and output capacitances are 6·3 pF and 4·8 pF respectively, and the sum of anode and screen currents is 15·7 mA. The valve construction has been described by Mueller (1814 of 1950).

621.375.2.024 **368**

A Method for the Amplification of Extremely Small Thermoelectric Voltages.—W. Kroebel. (*Z. angew. Phys.*, Aug. 1953, Vol. 5, No. 8, pp. 286–291.) A more detailed account of the d.c. amplifier noted in 2276 of 1953 is given. The threshold voltage is $\sim 1{\cdot}5 \times 10^{-9}$ V, with a source impedance of $\sim 10\,\Omega$. A circuit diagram including component values is given.

621.375.2.029.62 + 621.385.3] : 621.396.822 **369**

Noise Factor of Conventional V.H.F. Amplifiers.—N. Houlding. (*Wireless Engr*, Nov. & Dec. 1953, Vol. 30, Nos. 11 & 12, pp. 281–290 & 299–306.) A simple treatment is presented; the various types of circuit and valve noise are indicated, the concept of available power is explained, and noise factor is defined in terms of available power gain. Analysis is given for triode input stages based on common-cathode, common-grid and common-anode connections. Experimental results are given for various amplifiers for a mid-band frequency of 45 Mc/s. Curves show the effect of source resistance on the mid-band noise factor and the variation of single-frequency noise factor over the band, and results are also tabulated for different valves and circuits. The best noise factor with a given valve can only be determined experimentally. The need for further improvement in the noise performance of valves is emphasized.

621.375.23.029.3 **370**

Multiple-Feedback Audio Amplifier.—J. M. Diamond. (*Electronics*, Nov. 1953, Vol. 26, No. 11, pp. 148–149.) The power output of the Williamson circuit is increased and the power-supply requirements reduced by using tetrode output valves with anode-to-grid feedback. See also 3387 of 1952 (Williamson & Walker).

621.375.232.4 **371**

Stability of a Grounded-Grid Amplifier.—W. P. Mundrashi. (*NachrTech.*, Aug. 1953, Vol. 3, No. 8, pp. 345–348. German translation of an article in *Radiotekhnika, Moscow*, 1951, Vol. 6, No. 2, pp. 64–71.) The general conditions are investigated for the self-excitation of u.h.f. grounded-grid amplifiers. The precise formula and an approximate one for the frequency, and the condition for self-excitation, are derived. The dependence of the stability of the amplifier on circuit constants is considered; the results are shown graphically.

621.375.3 **372**

Methods of Magnetic Amplifier Analysis.—L. A. Finzi & G. F. Pittman, Jr. (*Elect. Engng, N.Y.*, Aug. 1953, Vol. 72, No. 8, pp. 690–694.)

621.376.56 **373**

P.C.M. Coding System uses Special Tubes.—A. G. Fitzpatrick. (*Electronics*, Nov. 1953, Vol. 26, No. 11, pp. 173–175.) The system uses a ten-target ribbon-beam switching tube for sampling and a tube with ten stable positions determined by crossed electric and magnetic fields for coding. Descriptions of tubes and circuit are given.

621.396.6 **374**

Printed Circuits: Some General Principles and Applications of the Foil Technique.—P. Eisler. (*J. Brit. Instn Radio Engrs*, Nov. 1953, Vol. 13, No. 11, pp. 523–538. Discussion, pp. 538–541.) Methods of producing printed circuits are discussed from the viewpoint of the printer; the foil technique is suitable for both general and special applications. The main processes involved, namely printing, etching, fusing, mechanical patterning, transfer and multilayer technique, are described. Various characteristics of foil conductors are examined and some particular applications are indicated.

621.396.822 **375**

Johnson Noise and Equipartition.—D. A. Bell. (*Proc. phys. Soc.*, 1st Aug. 1953, Vol. 66, No. 404B, pp. 714–715.) Discussion on 2847 of 1953 (Lindsay & Sims).

GENERAL PHYSICS

535.233 **376**

The Value of the Constant in Wien's Displacement Law.—A. H. Boerdijk. (*Philips Res. Rep.*, Aug. 1953, Vol. 8, No. 4, pp. 291–303.) The observed value of the wavelength at which maximum radiation occurs for a black body at a given temperature depends on the band-pass characteristics of the instrument used; as a consequence, Wien's constant can assume different values.

535.376 **377**

Demonstration of Electroluminescence by means of a Multilayer Colour Film.—G. Wendel. (*Ann. Phys., Lpz.*, 2nd July 1953, Vol. 12, Nos. 4/6, pp. 222–226.) Contact photographs were made of electroluminescence effects in a ZnO, ZnS-Cu phosphor, at field strengths of 10–100 kV/cm and a frequency of 50 c/s. The results indicate a direct excitation process, without the intermediate step of a gas discharge.

535.42 **378**

The Diffraction of an Arbitrary Pulse by a Wedge.—I. Kay. (*Commun. pure appl. Math.*, Aug. 1953, Vol. 6, No. 3, pp. 419–434.) An extension of the conical-flow method used by Keller & Blank (2963 of 1951). The coordinates chosen are such that the characteristic cone and the two planes intersecting to form the wedge each become constant coordinate surfaces. The problem is

then solved by separating variables and expanding the boundary conditions in terms of solutions of the ordinary differential equations which appear. The results are shown to apply to the special case investigated by Keller & Blank.

535.42 : 538.566 379

Theory of Diffraction of Electromagnetic Waves at a Perfectly Conducting Disk, and Related Problems.—J. Meixner. (*Ann. Phys., Lpz.*, 2nd July 1953, Vol. 12, Nos. 4/6, pp. 227–236.) The problem considered in 2767 of 1950 (Meixner & Andrejewski) for plane e.m. waves is solved generally for the case of spherical waves. Particular solutions are also obtained for the diffraction at an ellipsoid of revolution for a solenoidal e.m. field. A method for the numerical solution is outlined for the case of diffraction at a disk, at a circular aperture and at an ellipsoid of revolution, valid for $\lambda > 0{\cdot}6a$ approximately, where a is the radius or half the distance between the foci, as appropriate.

535.43 : 538.566 380

Scattering of Electromagnetic Waves at an Uneven Surface.—Yu. P. Lysanov. (*C. R. Acad. Sci. U.R.S.S.*, 11th Dec. 1952, Vol. 87, No. 5, pp. 719–722. In Russian.) Scattering of waves incident at an angle such that no part of the surface is in a shadow is considered theoretically. Application of the results to two particular cases shows that surfaces of a trochoidal form will give appreciably greater backscatter than a sinusoidal surface of the same 'amplitude' and 'wavelength'.

537.311.33 : 537.311.1 381

The Theory of Electronic Conduction in Polar Semiconductors.—D. J. Howarth & E. H. Sondheimer. (*Proc. roy. Soc. A*, 11th Aug. 1953, Vol. 219, No. 1136, pp. 53–74.) The present problem has been considered before by several authors [e.g., Wright (1577 of 1952)], but many of the results which have been given are either incorrect or only correct within certain limits. By solving the Boltzmann equation for the velocity distribution function of the conduction electrons in a crystal in which the scattering is due to the polarization waves of the lattice, exact expressions are obtained for the electrical conductivity and the thermoelectric power in the form of ratios of infinite determinants. Simple approximate solutions are derived and are used in the discussion of the dependence of conduction phenomena upon the temperature and upon the degree of degeneracy of the electron gas.

537.311.62 382

The Transient Period of the Skin Effect.—D. Zanobetti. (*R. C. Accad. naz. Lincei*, June 1953, Vol. 14, No. 6, pp. 791–795.) Analysis is given for the distribution of current in cylindrical conductors (solid or hollow) during the period between application of a voltage and attainment of a steady state.

537.311.62 383

Impedance of Solid and Hollow Cylindrical Conductors to Current Pulses.—D. Zanobetti. (*R. C. Accad. naz. Lincei*, Sept./Oct. 1953, Vol. 15, Nos. 3/4, pp. 200–202.) Continuation of work noted in 382 above. A quantitative solution is obtained for the initial value of the ratio between the instantaneous voltage and current.

537.52 384

Electrical Discharges.—F. L. Jones. (*Rep. Progr. Phys.*, 1953, Vol. 16, pp. 216–265.) Recent work on electrical discharges is surveyed under the following headings:—the breakdown of gases in static fields; high-frequency discharges; cold-emission phenomena; the regime of space charges. Breakdown is regarded as a consequence of the development of pre-breakdown ionization currents by primary and secondary processes which are themselves controlled by the nature and geometry of the cathode. The important part played by surface films in the cold extraction of electrons from electrodes is described. R.f. plasma oscillations and the generation of noise by discharges is discussed. 216 references.

537.523.4 : 537.533 385

Fundamental Processes of the Initiation of Electrical Discharges.—C. G. Morgan & D. Harcombe. (*Proc. phys. Soc.*, 1st Aug. 1953, Vol. 66, No. 404B, pp. 665–679.) The production of electrons initiating the spark discharge from polished and tarnished metal surfaces was investigated. The field applied was of the order of 10^5 V/cm.

537.533 : 537.534.8 386

Electron Emission resulting from the Impact of Ions on Molybdenum and Carbon Targets.—G. Philbert. (*C. R. Acad. Sci., Paris*, 19th Oct. 1953, Vol. 237, No. 16, pp. 882–883.) Experiments were made using normally incident polyatomic ions of energy between 1 and 2 keV. The number and energy distribution of the emitted electrons did not depend on the target material. The energy distribution of the electrons was independent of the nature and energy of the incident ions, but the number of electrons emitted per ion increased with the energy of the ions and depended on the nature of the ions.

538.3 : 537.122 387

A Variational Formulation of the Multi-stream Electrodynamic Field Equations.—P. N. Butcher. (*Phil. Mag.*, Sept. 1953, Vol. 44, No. 356, pp. 971–979.) "A non-relativistic approximation to Dirac's new variational formulation of the single-stream electrodynamic field equations is presented using 3-vector notation and m.k.s. units throughout. The Hamilton-Jacobi theory of a rotational space charge stream is developed. The variational formulation is generalized to the multi-stream case—both for a finite number and a non-denumerably infinite number of streams."

538.52 388

Induction Phenomena consequent on the Movement of Material in Primary Magnetic Fields, and their Experimental Applications: Part 2 — Translation.—H. Hinteregger. (*Acta phys. austriaca*, May 1953, Vol. 7, No. 2, pp. 129–145.) The Minkowski field equations are presented in a form to suit the particular conditions. A definition is given of apparent dielectric constant. Sommerfeld's treatment of unipolar induction is extended to magnetizable bodies. Unipolar induction in the case of translational motion is identified with e.s. induction in the material at rest. Part I: 118 of January.

538.561 : 537.523.5 389

The Hissing Arc and Radio-Frequency Self-Generated Oscillations in the D.C. Carbon Arc.—B. H. List & T. B. Jones. (*Elect. Engng, N.Y.*, Aug. 1953, Vol. 72, No. 8, pp. 683–686.)

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523 : 621.396.822 390

Radio Astronomy: Part 1 — Methods of Observation.—W. Dieminger. (*Arch. elekt. Übertragung*, Sept. 1953, Vol. 7, No. 9, pp. 421–427.) Theory and technique of methods of observing extraterrestrial sources of r.f. radiation are reviewed.

523.72 : 621.396.822 391

Evidence of Harmonics in the Spectrum of a Solar Radio Outburst.—J. P. Wild, J. D. Murray & W. C.

Rowe. (*Nature, Lond.*, 19th Sept. 1953, Vol. 172, No. 4377, pp. 533–534.) Measurements of r.f. outbursts on November 21, 1952, and May 5, 1953, show a dynamic spectrum comprising two widely spaced frequency bands having a drift with time from high to low frequencies. The ratio between frequencies of corresponding peaks was close enough to 2 to suggest a harmonic relation between the bands. The emission may take place in the corona at frequencies equal to the natural plasma frequency and its harmonics.

523.752 : 523.72 : 621.396.822 **392**

Radio Observations at the Time of an Ascending Solar Prominence.—R. D. Davies. (*Nature, Lond.*, 5th Sept. 1953, Vol. 172, No. 4375, pp. 447–448.) The solar prominence reported by Das & Sethumadhavan (393 below) was observed in Sydney, and records of radiation on 62, 98, 209, 600, 1200, 3000 and 9400 Mc/s were obtained. Noise bursts preceding and following the eruption were also recorded.

523.752 : 621.396.822 **393**

Eruptive Prominence of February 26, 1953, and Associated Radio Noise-Burst.—A. K. Das & K. Sethumadhavan. (*Nature, Lond.*, 5th Sept. 1953, Vol. 172, No. 4375, pp. 446–447.) Three bursts of noise associated with the prominence were recorded at Kodaikanal, with a radio telescope working on 100 Mc/s. These occurred when the topmost parts of the prominence were at about 50 000, 140 000 and 184 000 km respectively above the limb, though present-day theory indicates that at 100 Mc/s radiation cannot ordinarily escape from the sun unless generated at a height $>$ 100 000 km. No active sunspot group was observed in the vicinity of the prominence.

523.8 : 621.396.822 **394**

Radio Radiation from the Supergalaxy.—J. D. Kraus & H. C. Ko. (*Nature, Lond.*, 19th Sept. 1953, Vol. 172, No. 4377, pp. 538–539.) A low-intensity source was observed in March 1953 on 250 Mc/s with position corresponding approximately to the plane of the local supergalaxy described by de Vaucouleurs.

523.85 : 621.396.822 **395**

The Galaxy Explored by Radio Waves.—H. C. van de Hulst. (*Observatory*, Aug. 1953, Vol. 73, No. 875, pp. 129–139.) The full text of the Halley Lecture for 1953. This includes a short account of radio astronomy and of the results of observations made at 21·1049 cm and other wavelengths.

523.852.21 : 621.396.822 **396**

A Search for Radio Emission from the Orion Nebula.—J. E. Baldwin. (*Observatory*, Aug. 1953, Vol. 73, No. 875, pp. 155–157.) Short report of interferometer observations at a frequency of 210 Mc/s.

523.854 : 621.396.822.029.55/.63 **397**

A Model of the Radio-Frequency Radiation from the Galaxy.—R. H. Brown & C. Hazard. (*Phil. Mag.*, Sept. 1953, Vol. 44, No. 356, pp. 939–963.) The model has been designed to give agreement both with the observed values of equivalent aerial temperature and with the observed isophotes over the frequency range 18·3 Mc/s–1·2 kMc/s. The actual mechanism of generation of radio energy is not discussed.

523.854.22 : 621.396.822 : 621.396.677.3.029.62 **398**

The Distribution of the Discrete Sources of Cosmic Radio Radiation.—Mills. (See 333.)

550.38 **399**

The South Magnetic Pole in 1952 and the Comparative Displacements of the North and South Poles from 1842 to 1952.—P. N. Mayaud. (*Ann. Géophys.*, July/Sept. 1953, Vol. 9, No. 3, pp. 266–276.)

550.38 **400**

Recording the Geomagnetic Field at Port Martin.—P. N. Mayaud. (*Ann. Géophys.*, July/Sept. 1953, Vol. 9, No. 3, pp. 256–265.) The records were obtained by the Adélie Land expedition during the period April 1951–January 1952. Details are given of methods and results.

550.384 : 621.317.7 **401**

Electromagnetic Variometer for the Vertical Component [of the geomagnetic field].—I. Özdogan. (*Ann. Géophys.*, April/June 1953, Vol. 9, No. 2, pp. 161–163.) An instrument for studying rapid field variations is described; it operates on the same principles as the electromagnetic seismograph.

551.510.534 : 523.38 **402**

Further Determinations of the Vertical Distribution of Ozone during Eclipses of the Moon.—H. K. Paetzold. (*Z. Naturf.*, May 1952, Vol. 7a, No. 5, pp. 325–328.)

551.510.535 **403**

Propagation Measurements in the Ionosphere with the Aid of Rockets.—J. C. Seddon. (*J. geophys. Res.*, Sept. 1953, Vol. 58, No. 3, pp. 323–335.) Measurements made at White Sands are reported. Continuous waves with harmonically related frequencies, namely 4·274 and 25·644 Mc/s, were radiated from the rocket to two ground stations. The higher-frequency wave is practically unaffected by the E layer, and serves as a reference. The ordinary and extraordinary components of the lower-frequency wave, with frequency multiplied by 6, are separately heterodyned with the reference wave. The refractive indices of the medium are determined from the resulting beat frequencies together with a determination of the geomagnetic field and of the electron collision frequency at one altitude; the Lorentz polarization term can be neglected. Results are given and discussed.

551.510.535 **404**

The Reflection Coefficient of the Long Wave.—T. Sato. (*Rep. Ionosphere Res. Japan*, June 1953, Vol. 7, No. 2, pp. 69–70.) The propagation equation is solved and the reflection coefficient deduced for long waves incident vertically on a region of low electron concentration such as that situated below the E layer. Results are given for two cases based on different assumptions regarding the vertical gradient of concentration; comparison of these calculated results with observations on 16-kc/s and 150-kc/s waves indicates that there is a considerable gradient of electron concentration in the layer.

551.510.535 **405**

Dissociative Recombination in the E Layer.—E. Gerjuoy & M. A. Biondi. (*J. geophys. Res.*, Sept. 1953, Vol. 58, No. 3, pp. 295–303.) An examination is made of the consequences of assuming that electrons in the E layer disappear mainly by dissociative recombination. It is shown that this assumption provides a far more satisfactory basis for explaining actual E-layer observations than ion-ion recombination, and that most of the atomic processes involved are amenable to accurate laboratory measurement.

551.510.535 **406**

Ionosphere Observations in the Kerguelen Islands.—J. Le Gall, B. Mongin & H. Munier. (*C. R. Acad. Sci., Paris*, 19th Oct. 1953, Vol. 237, No. 16, pp. 927–928.) An ionosphere station has been established by the S.P.I.M. at Port aux Français (49·6°S, 70°E); regular observations started in February 1953. Monthly mean

values of f_0F_2 and f_0E_s for six months are tabulated; the results demonstrate the great influence of the geomagnetic field.

551.510.535 **407**

Some Regularities of the Ionospheric F Region.—B. Chatterjee. (*J. geophys. Res.*, Sept. 1953, Vol. 58, No. 3, pp. 353–362.) The F_2-layer regularities observed by Ratcliffe (1294 of 1952) are confined to a few stations only, and disappear when the bifurcation of the F layer is large. If the ion content of the F_1 and F_2 layers is considered as a whole, the regularities become much more marked and are observed at Slough, Falkland Islands and Singapore, even when the bifurcation is large. Peaks observed in the monthly mean values are attributed to tidal effects. The results are in conformity with the view that the F_1 and F_2 layers constitute a single ionization region.

551.510.535 : 525.624 **408**

Lunar Tidal Variations in the Sporadic-E Region.—S. Matsushita. (*Rep. Ionosphere Res. Japan*, June 1953, Vol. 7, No. 2, pp. 45–52.) Lunar tidal variations in the E_s layer are deduced from a statistical study of records from various stations. The maximum amplitude of the lunar semidiurnal variation of fE_s for a period of a year resembles that of the F_2 layer; in summer it is larger than that of the F_2 layer, especially in middle latitudes. The magnitude of the height variation is similar to that of the F_1 layer. The maximum height variation occurs about six hours after the lunar culminations, and the maximum value of fE_s two or three hours later. Possible explanations of the phenomena are discussed.

551.510.535 : 550.384 **409**

The Distribution of the Ionospheric Disturbances during the Geomagnetic Bay.—H. Kamiyama. (*Rep. Ionosphere Res. Japan*, June 1953, Vol. 7, No. 2, pp. 70–71.) A statistical analysis based on ionospheric data obtained at 35 widely distributed stations.

551.510.535 : 550.384 **410**

On a Change in Geomagnetic Declination accompanying Intense Sporadic-E-layer Ionization.—H. Hojo & T. Yonezawa. (*Rep. Ionosphere Res. Japan*, June 1953, Vol. 7, No. 2, pp. 61–67.) Analysis of geomagnetic and ionospheric data obtained at Kakioka and Kokubunji respectively indicate that the geomagnetic declination exhibits increased diurnal variation a few hours after the appearance of an intense E_s layer. It is inferred that the E_s-layer ionization is probably due to the incidence of particles.

551.510.535 : 551.594.12 **411**

A Procedure for the Determination of the Vertical Distribution of the Electron Density in the Ionosphere.—D. H. Shinn. (*J. geophys. Res.*, Sept. 1953, Vol. 58, No. 3, pp. 416–418.) Comment on 409 of 1953 (Kelso). See also 1997 of 1953 (Manning).

551.510.535 : 621.396.11 **412**

Optic Axes and Critical Coupling in the Ionosphere.—N. Davids. (*J. geophys. Res.*, Sept. 1953, Vol. 58, No. 3, pp. 311–321.) The similarity between the phenomena of double refraction in crystals and in the ionosphere is discussed [2868 of 1952 (Lange-Hesse)]. The ionosphere problem is studied by introducing a reference system based on the principal directions of the three-dimensional dielectric ellipsoid; these depend only on the direction of the earth's field, and are essentially constant over the ionosphere. Optic axes can exist in the ionosphere in the presence of collisions, and this is precisely the condition for critical coupling between the ordinary and extraordinary modes. The analysis is illustrated by reference to a possible set of ionospheric conditions.

551.578.1 : 551.594.25 **413**

Raindrop Charge and Electric Field in Active Thunderstorms.—R. Gunn & C. Devin, Jr. (*J. Met.*, Aug. 1953, Vol. 10, No. 4, pp. 279–284.) Measurements on over 7 000 drops are reported; the average charge was 0·022 e.s.u. for positively charged drops and 0·031 e.s.u. for negatively charged drops.

551.578.4 : 551.594.6 **414**

On the Electrification of Snow.—H. Norinder & R. Siksna. (*Tellus*, Aug. 1953, Vol. 5, No. 3, pp. 260–268.) An account is given of experimental investigations of the charging produced by (*a*) pouring snow from a vessel into a funnel, and (*b*) blowing snow on to an insulated target. The results are relevant to problems of precipitation static.

551.578.7 : 621.396.96 **415**

Radar Echoes from a Growing Thunderstorm.—R. Wexler. (*J. Met.*, Aug. 1953, Vol. 10, No. 4, pp. 285–290.) The growth of hail in cumulus clouds is studied theoretically in relation to the first appearance of radar echoes. The results are in good agreement with earlier observations.

551.594.5 **416**

Auroral Radio-Echo Table and Diagram for a Station in Geomagnetic Latitude 56°.—J. C. Cain. (*J. geophys. Res.*, Sept. 1953, Vol. 58, No. 3, pp. 377–380.)

551.594.5 : 621.396.822 **417**

Radio Noise from Aurora.—R. P. Chapman & B. W. Currie. (*J. geophys. Res.*, Sept. 1953, Vol. 58, No. 3, pp. 363–367.) Failure of attempts made during 1951 and 1952 to detect 10-cm auroral radiation observed in 1949 [3139 of 1949 (Forsyth et al.)] is attributed to the decreased intensity of auroral displays and of sunspot activity.

551.594.6 : 551.555.6 **418**

Electrical Properties of the Blizzard.—M. Barré. (*Ann. Géophys.*, April/June 1953, Vol. 9, No. 2, pp. 164–183.) The programme of the 1951 expedition to Adélie land was not intended to cover the study of blizzards, but the interference with radio reception due to this cause was found to be so bad that an investigation was instituted. When a meter was connected between the aerial feeder of the atmospherics receiver and earth, a current of 30–50 μA was observed, varying with the intensity of the wind; some days later, in identical weather conditions, the same current intensities were measured, but with reversed sign. To explain this result, extended measurements were made of the charge collected, using horizontal aerials arranged at right angles to the wind. The r.f. noise spectrum of the blizzard was also studied, using a receiver with a frequency range of 4–15 Mc/s. Records were also made of reception of WWV and WWVH on 5, 10, 15 and 20 Mc/s, for correlation with anemometer and charge records. The results indicate that the sign of the charge collected depends on the temperature of the blizzard, reversal occurring at about -15°C. The r.f. noise is closely related to the wind and intensity of the blizzard.

551.594.6 : 621.396.11 **419**

Audio-Frequency Spectrum of Atmospherics.—F. W. Chapman & W. D. Matthews. (*Nature, Lond.*, 12th Sept. 1953, Vol. 172, No. 4376, pp. 495–496.) Results are reported of simultaneous recordings of the frequency components in the band 40 c/s–16 kc/s. The frequency of the largest component in the 'slow tail' decreases as source distance increases and is higher at night than by day, while for the oscillatory part the opposite effect occurs. Selective attenuation at frequencies around 2 kc/s is indicated.

551.594.6 : 621.396.11 **420**

The Variation with Distance in the Range 0–100 km of Atmospheric Waveforms.—R. B. Morrison. (*Phil. Mag.*, Sept. 1953, Vol. 44, No. 356, pp. 980–986.) Records of the electric-field variation of a violent thunderstorm, made at distances of 10–100 km, are analysed over portion (*b*), which covers the large and rapid increase in field strength corresponding to the return stroke of the lightning discharge. Theoretical and experimental results for the waveform, the ratio of the maximum e.s. field to the net e.s. change, and the current in the discharge, are in fair agreement.

551.510.535 **421**

Die Ionosphäre. [Book Review]—K. Rawer. Publishers: P. Noordhoff N. V., Groningen, 1952, 189 pp., 14·50 florins. (*Nature, Lond.*, 19th Sept. 1953, Vol. 172, No. 4377, p. 514.) ". . . intended primarily for the physicist who wishes to make a rapid survey of ionospheric physics . . . Space has been found, in most cases, not only for a brief review of the background but also for an indication of more recent developments."

LOCATION AND AIDS TO NAVIGATION

621.396.91 : 551.508.1 **422**

A New Radio Theodolite.—V. Väisälä. (*Proc. Indian Acad. Sci. A*, Feb. 1953, Vol. 37, No. 2, pp. 223–228.) A preliminary account is given of a fixed-aerial system developed for tracking the Finnish Väisälä-7 radiosonde, which uses a wavelength of 12·5 m.

621.396.932 : 621.396.96 **423**

An Improved Marine Radar Set.—(*Engineer, Lond.*, 21st Aug. 1953, Vol. 196, No. 5091, pp. 248–249; *Engineering, Lond.*, 21st Aug. 1953, Vol. 176, No. 4569, pp. 236–237.) Description of the Kelvin Hughes Type-2C equipment, which has a 12-in. p.p.i. with four scale ranges, with a maximum range of 50 miles.

621.396.96 : 551.578.12 **424**

Utility of Radar in Measuring Areal Rainfall.—G. E. Stout & J. C. Neill. (*Bull. Amer. met. Soc.*, Jan. 1953, Vol. 34, No. 1, pp. 21–27.) A comparison was made of rainfall estimates for a 50-square-mile area obtained from (*a*) radar observations and (*b*) a network of 33 rain gauges. The radar determination was, in the least satisfactory case, as accurate as that obtained with a network of 1 gauge/200 square miles; in other cases it was considerably more accurate.

621.396.96 : 621.397.26 **425**

Radar Relay.—F. Kirschstein. (*Fernmeldetech. Z.*, Aug. 1953, Vol. 6, No. 8, pp. 389–395.) Several systems suitable for the transmission of p.p.i. displays are considered theoretically and an estimate is made of the bandwidths required. The usefulness of such systems for air-traffic-control is noted.

621.396.963.3 + 621.396.932 **426**

Recent Maritime Radio and Radar Developments.—Byrnes. (See 531.)

MATERIALS AND SUBSIDIARY TECHNIQUES

531.788.7 **427**

Sorption and Desorption of Gas in the Cold-Cathode Ionization Gauge.—J. H. Leck. (*J. sci. Instrum.*, Aug. 1953, Vol. 30, No. 8, pp. 271–274.) The rate of clean-up was measured for several gases and vapours, including N, A and water vapour, at pressures between 10^{-6} and 10^{-4} mm Hg; an estimate is made of the influence of the process on the accuracy of the gauge.

531.788.7 **428**

Wide-Range Vacuum Gage.—C. B. Sibley & J. R. Roehrig. (*Electronics*, Nov. 1953, Vol. 26, No. 11, pp. 176–177.) A development of the gauge described by Mellen (1867 of 1946), covering the range 10^{3}–10^{-4} mm Hg.

535.37 **429**

The Chemistry of Traps in Zinc Sulfide Phosphors.—W. Hoogenstraaten. (*J. electrochem. Soc.*, Aug. 1953, Vol. 100, No. 8, pp. 356–365.) By varying the coactivators in ZnS-Cu, the trap depth could be varied between 0·37 eV and 0·74 eV. The coactivators investigated were Cl, Br, Al, Sc, Ga and In ions. Additional glow peaks and traps were produced by oxygen and the killers Co and Ni. The formation of mixed crystals with CdS and ZnSe generally resulted in a shift of the glow curves towards lower temperatures.

535.37 **430**

Some Properties of Zinc Sulfide Activated with Copper and Cobalt.—W. Hoogenstraaten & H. A. Klasens. (*J. electrochem. Soc.*, Aug. 1953, Vol. 100, No. 8, pp. 366–375.) The thermal glow, decay and build-up of fluorescence, temperature dependence and the light sum for ZnS-Cu-Co phosphors excited by 3 650 Å radiation, were investigated experimentally. Most of the results are explained by means of a model in which Co levels act both as 0·5-eV electron traps and as acceptors for holes ejected thermally from Cu centres with an activation energy of 1·1 eV.

535.37 : 621.385.832 **431**

The Efficiency of Fluorescence in Cathode-Ray Tubes.—A. Bril & H. A. Klasens. (*Philips tech. Rev.*, Aug. 1953, Vol. 15, No. 2, pp. 63–72.) See 3607 of 1953.

537.311.33 **432**

Conduction Mechanisms in Semiconductors.—H. Krömer. (*Fernmeldetech. Z.*, Sept. 1953, Vol. 6, No. 9, pp. 438–443.) The first paper of a series on transistors, intended for engineers.

537.311.33 : 538.632 **433**

On the Theory of the Isothermal Hall Effect in Semiconductors.—P. C. Banbury, H. K. Henisch & A. Many. (*Proc. phys. Soc.*, 1st Aug. 1953, Vol. 66, No. 404A, pp. 753–758.) "The theory of the isothermal Hall effect is re-examined, taking into account the finite dimension of the specimen in the direction of the Hall e.m.f. This involves consideration of concentration gradients, space charges, recombination processes and floating potential at the Hall electrodes. The analysis leads to recommendations concerning experimental technique."

537.311.33 : 546.281.26 **434**

Semiconductor Complexes forming Nonlinear Resistors: Recent Improvements.—S. Teszner, P. Seguin & J. Millet. (*Ann. Télécommun.*, Aug./Sept. 1953, Vol. 8, Nos. 8/9, pp. 271–298.) The properties of semiconductors and the nature of their departures from Ohm's law are discussed. A description is given of the preparation of materials with a SiC base; their electrical properties are described and a tentative theory of the mechanism of conduction is presented. Investigations are described with a view to the development of materials with more pronounced nonlinear characteristics. Two types of complex were developed. Type 1 incorporated BeO or MgO, the best results being obtained with 65–66% SiC, 29–31% clay and 4–5% BeO or MgO. Type 2 received special thermal treatment, some containing 65% SiC, 30% clay and 5% MgO, others consisting of 65% SiC, 31% clay and 4% of a Ni-Be or Ni-Mg alloy. The results obtained with Type-1 materials show that the introduction of MgO or BeO increases considerably the l.v.

resistance. In Type-2 materials the initial resistance on application of a high voltage is very great compared with the final resistance, the ratio being much greater than in the case of materials without the MgO or alloy additions. Various possible applications of these new materials are suggested.

537.311.33 : 546.289 **435**

On the Thermal Conversion of Germanium.—F. van der Maesen, P. Penning & A. van Wieringen. (*Philips Res. Rep.*, Aug. 1953, Vol. 8, No. 4, pp. 241–244.) Experimental results indicate that conversion of *n*-type into *p*-type Ge at 800°C is due to the presence of acceptor impurities on the Ge surface prior to heating. Heating *n*-type Ge in contact with Cu or Ni resulted in a conversion; no conversion was observed with Mg, Fe or Ag.

537.311.33 : 546.561-31 **436**

The Semiconductor Properties of Cu_2O: Part 4 — Conductivity Measurements at High Temperatures.—O. Böttger. (*Ann. Phys., Lpz.*, 16th April 1953, Vol. 12, Nos. 1/3, p. 160.) Correction to paper abstracted in 1386 of 1953.

537.311.33 : 546.561-31 **437**

The Semiconductor Properties of Cu_2O: Part 6 — The Temperature Dependence of the Electrical Conductivity at Temperatures between + 20°C and — 190°C.—G. Blankenburg & G. Schubart. (*Ann. Phys., Lpz.*, 2nd July 1953, Vol. 12, Nos. 4/6, pp. 281–296.) The results indicate the importance of the controlled cooling of semiconductors pre-treated at high-temperature, to obtain uniform, reproducible properties. Part 5: 1387 of 1953 (Blankenburg & Böttger).

537.311.33 : 546.561-31 **438**

The Semiconductor Properties of Cu_2O: Part 7 — The Hall Effect below Room Temperature.—H. Nieke. (*Ann. Phys., Lpz.*, 2nd July 1953, Vol. 12, Nos. 4/6, pp. 297–308.) Hall-effect measurements at + 50°C to − 150°C are reported. The influence of the oxygen pressure during the cooling from the pretreatment temperature of 960°C was investigated. Part 6: 437 above.

537.311.33 : [621.314.632 + 621.314.7 **439**

Semiconductor Circuit Elements.—J. S. Blakemore, A. E. De Barr & J. B. Gunn. (*Rep. Progr. Phys.*, 1953, Vol. 16, pp. 160–215.) Theory of the conduction mechanism in semiconductors and semiconductor/metal systems is reviewed, mainly in relation to materials such as Ge and Si, whose special properties depend on the simultaneous flow of electrons and holes. Magnetic and optical effects and noise are discussed. Rectification and transistor action at semiconductor/metal contacts and *p-n* junctions are considered, and the properties of crystal diodes and transistors are described. 105 references.

537.311.33 + 621.385.032.21] : 621.396.822 **440**

Note on Shot Effect in Semi-Conductors and Flicker Effect in Cathodes.—van der Ziel. (See 605.)

537.311.33 + 621.385.032.21] : 621.396.822 **441**

Theory of the Flicker Effect.—Tomlinson & Price. (See 606.)

538.213 **442**

Complex Magnetic Permeability of Spherical Particles.—J. R. Wait. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, pp. 1664–1667.) Calculations are made of the effective permeability for an array of conducting particles embedded in a dielectric. The relations between conductivity, permeability, permittivity, particle radius and frequency are shown in curves.

538.221 **443**

Ferromagnetic Resonance in Colloidal Suspensions.—D. M. S. Bagguley. (*Proc. phys. Soc.*, 1st Aug. 1953, Vol. 66, No. 404A, pp. 765–767.) Measurements have been made of the absorption at 290°K and λ 3·14 cm and 1·20 cm, using suspensions of ferromagnetic particles in paraffin wax. The results indicate that the method is useful for investigating the properties of ferromagnetic alloy systems.

538.221 **444**

The Dependence of Ferromagnetic Resonance in Parallel Wires on the Tension.—A. G. Kotov. (*C. R. Acad. Sci. U.R.S.S.*, 1st Dec. 1952, Vol. 87, No. 4, pp. 531–533. In Russian.) The variation of the magnitude of the ferromagnetic-resonance effect in hardened Ni and Fe wires with the tensile stress and the axial magnetic field is shown graphically.

538.221 **445**

The Effect of Small Elastic Tensions on the Initial Susceptibility of Ferromagnetic Materials.—Ya. S. Shur & D. D. Mishin. (*C. R. Acad. Sci. U.R.S.S.*, 1st Dec. 1952, Vol. 87, No. 4, pp. 543–546. In Russian.) The initial susceptibility/tensile-stress characteristics of permalloy and various other steels depend on the previous magnetic history and on the crystallographic structure of the specimen. The susceptibility/tensile-stress curves for several specimens are shown.

538.221 **446**

Comparison of the Effects of Tension and Compression on the Magnetic Characteristics of Mild Steel.—G. Vidal & P. Lanusse. (*C. R. Acad. Sci., Paris*, 19th Oct. 1953, Vol. 237, No. 16, pp. 902–904.) The following sequence of operations was used for the tests:—(*a*) application of stress, (*b*) demagnetization, (*c*) application of magnetizing field, (*d*) measurement of induction. Results are presented graphically.

538.221 **447**

Secondary Recrystallization Textures in Soft Iron.—R. Guihaumé, M. Sternberg & P. Lacombe. (*C.R. Acad. Sci., Paris*, 19th Oct. 1953, Vol. 237, No. 16, pp. 904–906.) An account of experiments in which large crystals were found to develop in armco specimens after cold working followed by heat treatment.

538.221 **448**

Recent Investigations of Magnetic-Reversal Domains.—C. Greiner. (*Ann. Phys., Lpz.*, 16th April 1953, Vol. 12, Nos. 1/3, pp. 89–100.)

538.221 **449**

Magnetic Measurements on Iron Amalgam with Reference to the Problem of Ferromagnetism and Grain Size.—A. Mayer & E. Vogt. (*Z. Naturf.*, May 1952, Vol. 7a, No. 5, pp. 334–340.)

538.221 **450**

The Barkhausen Effect in Single Crystals.—R. S. Tebble & V. L. Newhouse. (*Proc. phys. Soc.*, 1st Aug. 1953, Vol. 66, No. 404B, pp. 633–641.) The results of measurements on single crystals of Si/Fe and Ni show that the Barkhausen effect is small and the magnetization process is mainly reversible, if the demagnetization factor of the specimen is large. It is suggested that the Barkhausen effect is associated with the movement of 180° rather than 90° boundaries.

538.221 **451**

Ferromagnetic Domain Processes in Single Crystal Disc Specimens of Silicon Iron.—D. H. Martin. (*Proc. phys. Soc.*, 1st Aug. 1953, Vol. 66, No. 404B, pp. 712–714.)

Changes in the domain structure of the surface layer due to changes in the direction of application of a magnetic field were observed and photographed.

538.222 : 539.15 **452**

Paramagnetic Resonance.—B. Bleaney & K. W. H. Stevens. (*Rep. Progr. Phys.*, 1953, Vol. 16, pp. 108–159.) An account is given of the principal phenomena associated with electronic magnetic resonance. Problems involved in its detection are reviewed. The theory of paramagnetism of the solid state is outlined and the spin-Hamiltonian is derived. The ions of the iron (3d) group and the rare-earth (4f) group are examined in terms of the spin-Hamiltonian. The influence of exchange interaction is discussed, and resonance in gases and other special compounds is treated briefly. 103 references.

538.245.002.2 **453**

Recent Progress in the Manufacture of Magnetic Materials: Ferronickels with Oriented Structure.—É. Josso. (*Ann. Télécommun.*, Aug./Sept. 1953, Vol. 8, Nos. 8/9, pp. 262–266.) Various methods of manufacturing oriented Ni-Fe materials are mentioned, the rectangular types of hysteresis curve for such materials are described and the magnetic characteristics are tabulated for a 50/50 Ni-Fe alloy (rectimphy) with a maximum permeability at 0·1 oersted of $8–14 \times 10^4$ and saturation induction of $15–16 \times 10^3$ gauss, and also for an alloy (permafix) with a constant permeability of 90–125, depending on heat treatment.

546.289 **454**

Theoretical Resistivity and Hall Coefficient of Impure Germanium near Room Temperature.—P. G. Herkart & J. Kurshan. (*RCA Rev.*, Sept. 1953, Vol. 14, No. 3, pp. 427–440.) The temperature variation of resistivity ρ over the range -100°C to $+140$°C has been calculated and plotted for both n-type and p-type Ge with varying impurity content corresponding to a resistivity range of 0·1–60Ω.cm at 25°C. The relations between ρ, impurity concentration and the Hall coefficient at 25°C are shown graphically. The mol-fraction of impurity is approximately $3·8 \times 10^{-8}/\rho$ for n-type and $8·1 \times 10^{-8}/\rho$ for p-type Ge over the range $0·1 < \rho < 20\Omega$.cm.

546.289 + 546.92] : 621.357.13 **455**

Electrolytic Polishing of Germanium and Platinum in the Presence of F^- or Cl^- Ions.—P. Brouillet & I. Épelboin. (*C. R. Acad. Sci., Paris*, 19th Oct. 1953, Vol. 237, No. 16, pp. 895–897.) Previous research on electrolytic polishing is applied to the cases of Ge and Pt. Details are given of ClNa-ClK and FNa-FK mixtures suitable for revealing the structure of Ge.

548.0 : 53 **456**

Physical Properties and Atomic Arrangements in Crystals.—W. A. Wooster. (*Rep. Progr. Phys.*, 1953, Vol. 16, pp. 62–82.) A survey is made of the relation between the structure of crystals and their magnetic, optical, piezoelectric and elastic properties. Recent work on paramagnetic resonance absorption at high frequencies is discussed in connection with the spinels. The spontaneous electric polarization of Rochelle salt and KH_2PO_4 is attributed to cooperative movements of hydrogen ions.

548.0 : 53 **457**

The Physical Properties of Crystals and their Symmetry.—M. Tournier. (*Cah. Phys.*, July 1953, No. 44, pp. 44–73.) Certain properties of crystals can be predicted from the elements of symmetry in the cause-and-effect relations of the phenomena associated with them. Tensor and matrix methods are used to express the pyroelectric, dielectric, piezoelectric and elastic processes. Various crystalline systems are examined, and an indication is given of the properties to be expected of them according to this analysis.

548.1 : 537.1 **458**

Interface Area, Edge Length, and Number of Vertices in Crystal Aggregates with Random Nucleation.—J. L. Meijering. (*Philips Res. Rep.*, Aug. 1953, Vol. 8, No. 4, pp. 270–290.)

548.5 : 549.514.51 **459**

Hydrothermal Synthesis of Quartz Crystals.—A. C. Walker. (*J. Amer. ceram. Soc.*, 1st Aug. 1953, Vol. 36, No. 8, pp. 250–256.) The method and the autoclave used to grow crystals, weighing over 1 lb each, in less than 60 days are described.

548.55 : 537.311.33 : [546.28 + 546.289 **460**

Apparatus for Crystal Pulling in Vacuum using a Graphite Resistance Furnace.—K. Lehovec, J. Soled, R. Koch, A. MacDonald & C. Stearns. (*Rev. sci. Instrum.*, Aug. 1953, Vol. 24, No. 8, pp. 652–655.) Apparatus suitable for producing large single crystals of Ge or Si is described. Independent rotation of crucible and crystal is provided. The crystal is withdrawn at a rate of up to 6 in./hour.

548.73 : 549.731.11 **461**

Physical and Crystallographical Properties of Some Spinels.—F. C. Romeijn. (*Philips Res. Rep.*, Aug. & Oct. 1953, Vol. 8, Nos. 4 & 5, pp. 304–320 & 321–342.) X-ray measurements on simple and complex spinels indicated regularities in ionic distribution and lattice constants. These are explained by a calculation of the Madelung potential, by geometrical considerations, and by the properties of the constituent ions. The calculated relation between the ionic distribution and the oxygen parameter u was confirmed. Some physical properties of the compounds investigated have been correlated with the ionic distribution.

621.314.632.1 **462**

Cuprous Oxide Rectifier Characteristics.—J. Lees. (*Proc. phys. Soc.*, 1st Aug. 1953, Vol. 66, No. 404B, pp. 622–632.) The current/voltage and the capacitance/reverse-voltage characteristic were determined at 0, 30 and 70°C; the latter was independent of temperature in this range. The assumption of a Schottky barrier is not compatible with the results obtained. A method of predicting the reverse current/voltage characteristic, giving results in good agreement with the experimental results, is derived.

621.315.612.4 **463**

Phase Equilibria in the System MgO-TiO_2.—L. W. Coughanour & V. A. DeProsse. (*J. Res. nat. Bur. Stand.*, Aug. 1953, Vol. 51, No. 2, pp. 85–88.) Report of an investigation in connection with the study of ceramic dielectrics.

621.315.612.4 : 537.226.2-972 **464**

Investigations in the Tenth-Millimetre Wavelength Region.—R. Meier. (*Ann. Phys., Lpz.*, 16th April 1953, Vol. 12, Nos. 1/3, pp. 26–34.) Types of grating used in the wavelength range 0·15–0·6 mm are described. The absorption bands of water vapour were partially resolved into absorption lines. The dielectric constants of Condensa N and F and Epsilan 900 and 7000 were determined from reflection-coefficient measurements; the results are shown graphically.

621.315.613.1 **465**

Alternatives to Mica.—E. R. Haines. (*Elect. Rev., Lond.*, 28th Aug. 1953, Vol. 153, No. 9, pp. 437–441.)

The electrical and mechanical properties of mica and various types of micanite are compared with those of materials of the glass-fibre and asbestos types. A material consisting of glass cloth backed with asbestos paper and fully impregnated with a plasticized-shellac varnish was found to have excellent electrical properties and, from the point of view of moulding, was superior to any mica-type material.

621.375.3.042 **466**

Evaluation of Core Materials for Magnetic Amplifiers.—D. C. Dieterly. (*Elect. Mfg.*, Jan. & Feb. 1953, Vol. 51, Nos. 1 & 2, pp. 68–73 . . 276 & 124–127, 380.)

MATHEMATICS

517.947.5 **467**

Self-Oscillation in Essentially Nonlinear Quasi-conservative Systems.—G. V. Savinov. (*C. R. Acad. Sci. U.R.S.S.*, 21st April 1953, Vol. 89, No. 6, pp. 995–997.) Systems are considered which can be represented by the equation $\ddot{x} + g(x) = \mu f(x, \dot{x}, \mu)$, where μ is a small magnitude characterizing the degree of quasi-conservativeness. This class includes physical systems containing $BaTiO_3$ capacitors or permalloy-cored inductors.

518.5 : 621.3.011 **468**

Pocket Reactance and Resonance Calculator.—V. J. Tyler. (*Wireless World*, Dec. 1953, Vol. 59, No. 12, pp. 560–562.) A simple calculator comprising six concentric disks and covering twelve decades without ambiguity.

MEASUREMENTS AND TEST GEAR

529.78(083.74) **469**

Pendulum, Quartz and Atomic Clocks as Time Standards.—A. Scheibe. (*Z. angew. Phys.*, Aug. 1953, Vol. 5, No. 8, pp. 307–317.) A survey of the development of standard-time clocks from 1932 to date is given. Comparison of the several types indicates the superiority of the quartz clock, although a Cs resonator may be developed for short-period accuracy checking. 37 references.

529.786 + 621.3.018.4(083.74)] : 621.372.412 **470**

Underearth Quartz Crystal Resonators.—T. A. Pendleton. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, pp. 1612–1614.) Precision quartz resonators are used in conjunction with oscillators for primary standards of frequency and time. Stable ambient conditions for such resonators are provided by locating them underground. A method is described for measuring resonator-frequency drift to within 2 parts in 10^{10}, using a direct voltage.

621.317 : 621.396.823 **471**

Measurement of Radio Interference generated by High-Voltage Lines.—D. Renaudin. (*Bull. Soc. franç. Élect.*, July 1953, Vol. 3, No. 31, pp. 425–431.) Discussion of the principles of measurement based on a statistical analysis of interference pulse trains due to brush discharges, and on the response of a receiver to this type of interference, taking account of bandwidth, circuit time-constants and type of detection. Specifications for a standard receiver for measurement purposes and the method of calibration by means of a special noise source are noted.

621.317.3 : 621.396.822 **472**

Fluctuation Theory in Physical Measurements.—C. W. McCombie. (*Rep. Progr. Phys.*, 1953, Vol. 16, pp. 266–320.) An elementary account is given of the ways in which fluctuation theory has been applied to some of the simpler types of physical measurement. Uncertainties in measurements involving suspended systems are discussed on the basis of simple correlation-function arguments, and consideration is given to the methods of measurement appropriate when there are various practical limitations on the parameters of the suspended system. The circumstances under which there is an absolute limit to the attainable accuracy are discussed; the use of feedback may enable such limits to be attained in practice. Some results are established concerning the optimum characteristics of an instrument used to follow a varying signal in the presence of noise. 78 references.

621.317.3.018.78 : 621.395.625.3 **473**

'Wow' Measurement.—D. W. Thomasson. (*Wireless World*, Dec. 1953, Vol. 59, No. 12, pp. 579–580.) A laboratory method for detecting 'wow' in tape recorders is described in which the output obtained on playing a test recording (e.g., of a 1-kc/s sine wave) is observed oscillographically. For production testing a further method is mentioned, using a frequency-measuring circuit in which a capacitor is charged and discharged during each signal cycle, the average discharge current being proportional to signal frequency.

621.317.33 **474**

The Measurement of the Electrical Resistance of Powders.—H. v. Wartenberg. (*Z. angew. Phys.*, Aug. 1953, Vol. 5, No. 8, pp. 291–292.) The concentration of an electrolyte is adjusted until an addition of the powder has no effect on the conductivity. The resistivities of the powder and electrolyte are then equal. Precautions against the formation of surface layers are outlined.

621.317.34.029.5/.63 **475**

Filter Insertion Loss in the 10–1000-Mc/s Range.—S. Shive. (*Tele-Tech*, June 1953, Vol. 12, No. 6, pp. 95–97 . . 184.) Standard attenuation-measurement technique is described. The importance of correct impedance matching, in order to avoid standing waves in the generator-filter-detector line, is pointed out.

621.317.35 : 621.3.018.78 : 534.851 **476**

Distortion in Phonograph Reproduction.—H. E. Roys. (*RCA Rev.*, Sept. 1953, Vol. 14, No. 3, pp. 397–412.) Reprint. See 2736 of 1953.

621.317.42 **477**

Three Methods of Measuring Magnetic Fields: Part 1 — Measurement based on the Generator Principle.—B. F. Jürgens. **Part 2 — Measurement of the Field on the Axis of Magnetic Electron Lenses.**—A. C. van Dorsten & A. J. J. Franken. **Part 3 — Measurement by the Proton Resonance Method.**—H. G. Beljers. (*Philips tech. Rev.*, Aug. 1953, Vol. 15, No. 2, pp. 49–62.) The principles of the first two of these methods are well known. In the third method, a small vessel of water is placed in the field to be measured. Application of a weak alternating field at right angles to this field causes the hydrogen nuclei to resonate; the resonance frequency is proportional to the strength of the field to be measured. A model with a range up to 14 000 gauss has been made. The error is $< 0{\cdot}01\%$.

621.317.7 : 621.396.82.029.62/.63 **478**

Measuring Equipment for Radio Interference in the U.S.W. Range.—H. Leingang. (*Rohde & Schwarz Mitt.*, May 1953, No. 3, pp. 120–125.) Equipment for measurement of continuous and discontinuous line and radiated interference in the frequency ranges 30–180 Mc/s and 85–330 Mc/s is described and illustrated. Calibration of the instruments is discussed. A graph showing the difference of the indicated interference level between British and German standard equipment is given.

621.317.73.029.6 **479**

Improved Accuracy and Convenience of Measurements with Type 1602-B Admittance Meter in V.H.F. and U.H.F. Bands.—R. A. Soderman. (*Gen. Radio Exp.*, Aug. 1953, Vol. 28, No. 3, pp. 1–6.) A modified model of the instrument noted in 163 of 1951 (Thurston) is described. The ranges have been extended to 10^{-4}–1 Ω^{-1} for measurement of conductance and susceptance at frequencies from 41 Mc/s to 1 kMc/s.

621.317.733 : 621.314.7 **480**

Bridges measure Transistor Parameters.—L. J. Giacoletto. (*Electronics*, Nov. 1953, Vol. 26, No. 11, pp. 144–147.) See 3359 of 1953.

621.317.755 : 621.375.221 : 621.376.3 **481**

A Method of Band-Pass Amplifier Alignment.—J. J. Hupert & A. M. Reslock. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, pp. 1668–1671.) The second-harmonic distortion is displayed on a c.r.o. as a function of the deviation of the carrier frequency from the centre of the pass band. The method is particularly useful for cases where linear variation of phase with frequency is required, e.g., in i.f. amplifiers for f.m. receivers. See also 3550 of 1953 (Hupert).

621.317.755 : 621.385 **482**

Determination of the Slope of an Electronic-Valve Characteristic by Time-Differentiation of the Anode Current.—R. Counord. (*C. R. Acad. Sci., Paris*, 19th Oct. 1953, Vol. 237, No. 16, pp. 879–881.) The method presented makes use of differentiators described by Rateau (1688 of 1952). The grid of the valve under test is fed with linearly increasing voltages from a sawtooth oscillator, and the anode current is passed through a differentiating circuit, the output of which is displayed on a c.r.o. whose timebase is derived from the same oscillator.

621.317.763.029.64 : 621.372.413 **483**

Construction and Calibration of a Cavity-Wavemeter for Physical Measurements.—J. C. van den Bosch & F. Bruin. (*Physica*, Aug. 1953, Vol. 19, No. 8, pp. 705–718.) The wavemeter described is constructed according to the design of Bleaney et al. (3187 of 1947) and operates in the 12·5-mm wavelength range. Using ammonia absorption lines for calibration, the resonance frequencies are determined to within 1 part in 10^4. Temperature dependence and compensation are discussed.

621.317.772 **484**

Zero-Intercept Phase Comparison Meter.—Y. P. Yu. (*Electronics*, Nov. 1953, Vol. 26, No. 11, pp. 178–180.) Two waveforms to be compared are fed to two separate circuits and a pulse is produced in each circuit when its input voltage crosses the zero axis. The first pulse initiates generation of a sawtooth voltage, while the second cuts off the sawtooth generator. The amplitude of the sawtooth is measured with a calibrated valve voltmeter which gives the phase angle between the two waveforms.

621.317.772 : 621.317.727 **485**

Electronic A.C. Potentiometer.—L. Tasny-Tschiassny. (*Wireless Engr*, Dec. 1953, Vol. 30, No. 12, pp. 295–298.) A simple arrangement for measuring phase differences is based on comparison between an unknown voltage and an adjustable known fraction of a reference voltage; operation is independent of frequency. A square-law detector is used. The apparatus is built from standard radio components.

621.373.4.029.63/.64 **486**

S-Band Sweep Generator and Test Set.—R. E. Larson. (*Tele-Tech*, June 1953, Vol. 12, No. 6, pp. 116–118 . . 164.) See 3671 of 1953 (Kluck & Larson).

621.373.42 **487**

A Novel Audio Sweep Generator.—P. Pohl & H. Wolcott. (*J. audio Engng Soc.*, July 1953, Vol. 1, No. 3, pp. 244–245.) Description of equipment for use with a c.r.o. to display a response curve. A frequency sweep between any two limits within the range 20 c/s–200 kc/s is available.

621.373.421.13 : 621.317.361.029.6 **488**

Microwave Frequency Standard.—L. C. Hedrick. (*Rev. sci. Instrum.*, Aug. 1953, Vol. 24, No. 8, pp. 565–568.) Details are given of a highly stable signal generator in which the final frequency of 810 Mc/s is derived in five stages of multiplication from the output of a 5-Mc/s crystal oscillator. An unknown microwave frequency to be measured is heterodyned against harmonics from this generator, and the resulting beat-frequency signal is fed to a calibrated communication receiver.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

531.768 : 546.431.824-31 **489**

Symposium on Barium Titanate Accelerometers.—(*Tech. News Bull. nat. Bur. Stand.*, Aug. 1953, Vol. 37, No. 8, pp. 125–126.) Brief note indicating the scope of the discussions at the symposium held in Washington, May 1953.

537.528 : 534.88 : 526.956.5 **490**

The Under-Water Spark as Sound-Pulse Generator.—H. Drubba & H. H. Rust. (*Arch. elekt. Übertragung*, Sept. 1953, Vol. 7, No. 9, pp. 429–440.) The discharge of a capacitor through an under-water spark gap was investigated, using inductance-free capacitors of 0·75, 1·25, 2·25, 4·25 and 6·25 μF with voltages up to 5 kV and electrode spacings of 0·1 and 0·3 mm. Oscillographic records were obtained of the current time curve, discontinuous increases being observed. The duration and shape of the pulses are interpreted on the assumption that the pulse traverses a gas/water boundary close to the spark channel. Photographs of the electrodes showing the effect of the spark, and photographs of the spark region taken 10^{-5}–10^{-4} sec after the breakdown are included. 138 references. See also 223 of January.

550.837 **491**

Principle of the Magneto-telluric Method, a New Method for Geophysical Prospecting.—L. Cagniard. (*Ann. Géophys.*, April/June 1953, Vol. 9, No. 2, pp. 95–125.) The method is based on quantitative relations existing between the horizontal components of the electric field and the magnetic field when current flows in the subsoil.

550.837.6 **492**

Modelling of Alternating Electromagnetic Fields for Geophysical Prospecting.—A. G. Tarkhov. (*Bull. Acad. Sci. U.R.S.S., sér. géophys.*, June/Aug. 1953, No. 4, pp. 318–323. In Russian.) The effect of conducting bodies in the upper layers of the earth on the magnetic field of an h.f. e.m. field was investigated experimentally by means of a scale model. The scaling-down factors for the conductivity γ and dielectric constant ϵ of the medium, the frequency f and the linear dimension l, were calculated from the equations $\gamma_1 f_1 l_1^2 = \gamma_2 f_2 l_2^2$ and $\epsilon_1 f_1^2 l_1^2 = \epsilon_2 f_2^2 l_2^2$. The observed distribution of the vertical component of the magnetic field is shown graphically.

621.383.2 : 536.521 **493**

A New Photoelectric Pyrometer.—A. Peuteman. (*C. R. Acad. Sci., Paris*, 28th Oct. 1953, Vol. 237, No. 17, pp. 975–977.) The vacuum-type photocell used has a Cs-Ag cathode and metal-cylinder anode; it is rendered

effectively monochromatic ($\lambda \sim 680$ mμ) by means of optical filters. An a.c. amplifier is used, the incident radiation being interrupted at about 600 c/s. The sensitivity is 1 mV for 5° at 1 600°C.

621.384.611 **494**

The Design and Operation of a 4·5 MeV Microtron.—C. Henderson, F. F. Heymann & R. E. Jennings. (*Proc. phys. Soc.*, 1st Aug. 1953, Vol. 66, No. 404B, pp. 654–664.) Description of a machine similar to that described by Redhead et al. (1472 of 1950), and operating with a r.f. accelerating field generated by a 500-kW peak microwave source at 3 kMc/s.

621.384.611 **495**

The Theory of the Fixed Frequency Cyclotron.—B. L. Cohen. (*Rev. sci. Instrum.*, Aug. 1953, Vol. 24, No. 8, pp. 589–601.)

621.384.612 **496**

Oscillator Switching for Variable Frequency Synchrotron Control.—D. E. Caro & L. U. Hibbard. (*Phil. Mag.*, Sept. 1953, Vol. 44, No. 356, pp. 964–970.)

621.384.622.2 **497**

Effect of Anomalous Attenuation in a Linear Accelerator.—C. W. Miller & G. Saxon. (*Nature, Lond.*, 5th Sept. 1953, Vol. 172, No. 4375, p. 463.)

621.385.833 **498**

Double Focusing of Charged Particles by a System of Two Magnets with Nonuniform Fields.—R. M. Sternheimer. (*Rev. sci. Instrum.*, Aug. 1953, Vol. 24, No. 8, pp. 573–585.)

621.385.833 : 530.145.6 **499**

Electron-Optical Image Formation based on Wave Mechanics.—W. Glaser & P. Schiske. (*Ann. Phys., Lpz.*, 2nd July 1953, Vol. 12, Nos. 4/6, pp. 240–280.)

621.387.422 **500**

On Energy Resolution with Proportional Counters.—G. S. Hurst & R. H. Ritchie. (*Rev. sci. Instrum.*, Aug. 1953, Vol. 24, No. 8, pp. 664–668.) Investigation of the dependence of the height of the output pulse on the orientation of the ionizing track and on the amplifier time constant.

621.387.424 **501**

Recent Developments in the Production of Halogen-Quenched Geiger-Müller Counting Tubes.—L. B. Clark, Sr. (*Rev. sci. Instrum.*, Aug. 1953, Vol. 24, No. 8, pp. 641–643.) G-M tubes have been constructed using transparent nonmetallic electrically conducting films as cathodes. Advantages of this construction are indicated.

621.387.424 **502**

The Starting Potential of Counter Tubes.—K. H. Lauterjung. (*Z. Naturf.*, May 1952, Vol. 7a, No. 5, pp. 344–351.)

PROPAGATION OF WAVES

621.396.11 : 551.510.52] : 061.3 **503**

The 1953 Symposium on Tropospheric Wave Propagation within the Horizon at the U.S. Navy Electronics Laboratory.—W. C. Hoffman. (*Trans. Inst. Radio Engrs*, July 1953, Vol. AP-1, No. 1, pp. 28–30.) Report of the symposium held 30th March–2nd April, outlining papers read.

621.396.11 : 551.510.535 **504**

The Effect of Ions on Magneto-ionic Characteristic Polarization.—W. Snyder. (*Trans. Inst. Radio Engrs*, July 1953, Vol. AP-1, No. 1, pp. 23–27.) A general formula for polarization in a mixture of ions and electrons is derived. The predicted polarization of a 100-kc/s and 300-kc/s downcoming wave component in a neutral mixture of oxygen ions, nitrogen ions and electrons is plotted as a function of Goubau's mixture coefficient k (3751 of 1935). The plots show that, in a mixture, (*a*) polarizations are possible that cannot occur when only electrons are present, (*b*) a given polarization does not uniquely determine k, and (*c*) polarization depends on relative numbers of each type of charged particle but not on actual charge density when the proportion of electrons is small.

621.396.11 : 551.510.535 **505**

Optic Axes and Critical Coupling in the Ionosphere.—Davids. (See 412.)

621.396.11 : 551.594.6 **506**

Audio-Frequency Spectrum of Atmospherics.—Chapman & Matthews. (See 419.)

621.396.11 : 551.594.6 **507**

The Variation with Distance in the Range 0–100 km of Atmospheric Waveforms.—Morrison. (See 420.)

621.396.11.029.6 : 550.38 **508**

Influence of the Geomagnetic Field on the Propagation of Short Waves. Application to the Calculation of Maximum Usable Frequency.—E. Argence. (*Ann. Géophys.*, July/Sept. 1953, Vol. 9, No. 3, pp. 227–244.) The theory presented is developed from a more general method previously noted (2315 of 1952). Approximate expressions for the refractive index are used for calculating s.w. propagation paths, a plane earth and ionosphere being assumed. Three special cases are examined in detail, viz., (*a*) propagation at the equator, (*b*) east-west propagation at any geomagnetic latitude, (*c*) propagation in the plane of the magnetic meridian; both ordinary and extraordinary rays are calculated. Various methods are discussed for using the results to simplify m.u.f. calculations. The effect of curvature of earth and ionosphere is discussed briefly. The method enables the wave polarization to be determined at any point in the path.

621.396.11.029.62 **509**

Long-Distance Propagation of Metre Waves.—B. Sadoun. (*Ann. Télécommun.*, Aug./Sept. 1953, Vol. 8, Nos. 8/9, pp. 299–308.) Since November 1952 records have been obtained at the Laboratoire National de Radioélectricité of the field strengths of f.m. broadcasting transmitters operating at frequencies of 88–100 Mc/s and at distances of 300–700 km from Paris. The method of measurement is described and typical records are reproduced. The results obtained show that, in addition to abnormal propagation phenomena of a sporadic nature, there exists at great distances a permanent field whose mean value is the more stable as the distance from the transmitter increases. This field strength is much greater than that calculated from wave diffraction round the earth. A tentative explanation is that a scattering of radio waves takes place in the troposphere. The records obtained during eight months show no marked diurnal effects; the variations observed during the day are often quite different from one day to another. Seasonal effects also are not very noticeable.

621.396.11.029.62 **510**

Note on the Frequency Bandwidth Usable for Long-Distance U.S.W. Transmissions.—J. Voge. (*Ann. Télécommun.*, Aug./Sept. 1953, Vol. 8, Nos. 8/9, pp. 308–311.) The results of Rice's theory (1473 of 1953) are applied to the transmission path between Wrotham and Bagneux, one of the paths studied by Sadoun (509 above).

The maximum usable bandwidth is found to be of the order of 100 kc/s at a distance of 300 km. This value is independent of the carrier frequency and varies inversely with the distance. This result has not yet been tested experimentally, but it should be noted that the application of Rice's formulae gives values in satisfactory agreement with the results obtained for the periods of fading and the dimensions of the volume in which scattering takes place.

621.396.81.029.64 511

Measurement of Path Loss between Miami and Key West at 3675 Mc/s.—R. L. Robbins. (*Trans. Inst. Radio Engrs*, July 1953, Vol. AP-1, No. 1, pp. 5–8.) Report of measurements made of the received field strength using 1·5-μs pulses transmitted over five transmission paths about 130 miles long, largely water-covered. Path loss and fading characteristics were similar to those for mountainous paths elsewhere [1114 of 1953 (Bullington)]. No differences were observed due to different terrain in front of the aerial.

621.396.812.3 : 551.510.535 512

Studies on Mechanism and Distribution of Short-Period Fading Reflected from Turbulent Ionosphere.—F. Minozuma & H. Enomoto. (*Rep. Ionosphere Res. Japan*, June 1953, Vol. 7, No. 2, pp. 53–59.) Fading phenomena are discussed in terms of the variations of optical paths produced by turbulence of the ionosphere. A simple model is proposed which fits observations of field strength made on 4-Mc/s and 8-Mc/s standard-frequency transmissions over distances of 90–830 km.

621.396.812.3.029.55 513

Statistical Investigations of Short-Wave Transmission Paths.—J. Grosskopf. (*Fernmeldetech. Z.*, Aug. 1953, Vol. 6, No. 8, pp. 373–378.) The statistical distribution of the signal amplitudes was determined for WWV signals received at Darmstadt; it is represented by a log-normal distribution curve. The fading characteristics at 10, 15 and 20 Mc/s were analysed statistically; the hourly scatter of the instantaneous field-strength values was 7 db and the monthly scatter of the hourly median values was 14 db. The device used for counting the frequency of occurrence of the various amplitudes is described.

RECEPTION

621.396.621 514

Development of German Broadcast Receivers from 1945 to 1953.—O. Limann. (*Elektrotech. Z., Edn B*, 21st Aug. 1953, Vol. 5, No. 8, pp. 246–251.) As a result of Germany's post-war frequency allocation, work has been largely concentrated on u.s.w. receivers. Models briefly described include modern a.m./f.m. superheterodyne sets with built-in aerial.

621.396.621 515

Circuit Refinements of 1953/54 [West German] **Broadcast Receivers.**—W. W. Diefenbach. (*Funk-Technik, Berlin*, Aug. 1953, Vol. 8, No. 15, pp. 456–457 . . 471.)

621.396.621 516

Improvements to the Communications Receiver BRT 400.—C. W. M. Read. (*G.E.C. Telecommun.*, April 1953, No. 16, pp. 40–47.) Modifications to the receiver noted in 2310 of 1949 include an extension of the adjustable i.f. bandwidth to 13 kc/s and improved oscillator stability for frequency-shift reception. A valve phase changer is used for cancelling the d.c. ripple, so that electrolytic smoothing capacitors can be dispensed with.

621.396.621 : 621.396.8 517

Figure of Merit of Broadcast [receiving] **Installations and Conditions for Undisturbed Reception.**—H. Schmalbruch. (*Z. Ver. dtsch. Ing.*, 11th Aug. 1953, Vol. 95, No. 23, pp. 774–776.) Aerial requirements in respect of height and interference-free location, and advantages of common-aerial reception are indicated. Criteria for estimating receiver performance as regards hum pickup, radiation, selectivity, etc., are given; an overall figure of merit for the installation is obtained by combining these assessments.

621.396.621.54 : 621.396.91 518

Radio Receiver for recording Time Signals.—A. Godefroy. (*Ann. Géophys.*, July/Sept. 1953, Vol. 9, No. 3, pp. 245–247.) A stable highly selective 90·9-kc/s receiver is described. A double-heterodyne system is used, oscillations from a single quartz-controlled local oscillator beating (*a*) with the incoming signal to give an i.f., and (*b*) with the i.f. to give the a.f.

621.396.823 + 621.397.823 519

Effect of Radio Interference generated by High-Voltage Lines on the Reception of Broadcast and Television Transmissions.—P. Passerieux. (*Bull. Soc. franç. Élect.*, July 1953, Vol. 3, No. 31, pp. 432–444.) Detailed results of measurements on different power lines are presented, showing the influence of the arrangement, voltage and surface condition of the conductors on the noise level due to corona discharge, and the effect of coupling between parallel lines on the propagation of a disturbance. Three types of interference trace on a television screen were identified; the number of these traces was very small at normal line voltages but increased greatly at excessive line voltages.

621.396.823 : 621.315.1.027.8 520

Experimental and Theoretical Study of the Mechanism of Propagation and Radiation of Interference from High-Voltage Lines.—J. Fabre. (*Bull. Soc. franç. Élect.*, July 1953, Vol. 3, No. 31, pp. 419–424.) Investigation of the field distribution and the spectrum of interference shows that receiver noise due to direct radiation from corona discharge is negligible compared with that due to propagation of the disturbance between line and earth. Frequency spectra of interference from short and long lines are compared. Attenuation as a function of distance along the line is calculated for 400- and 127-kV lines.

621.396.823 : 621.315.1.027.8 521

Radio Interference from Very-High-Voltage Lines.—R. Pélissier. (*Bull. Soc. franç. Élect.*, July 1953, Vol. 3, No. 31, pp. 409–418.) The mechanism of corona discharge and the propagation of a disturbance along the lines are discussed with reference to measurements made on different power lines, particularly at a 500-kV experimental station at Chevilly. Received-noise spectra are analysed. A relation between effective noise power and the ratio applied-voltage critical-voltage is derived by which the maximum noise field strength close to a projected line can be estimated.

621.396.823 : 621.317 522

Measurement of Radio Interference generated by High-Voltage Lines.—Renaudin. (See 471.)

621.396.828 523

Progress in Radio-Interference Suppression.—W. Scholz. (*Fernmeldetech. Z.*, Aug. 1953, Vol. 6, No. 8, pp. 385–388.) The measurement of interference at frequencies between 150 kc/s and 328 Mc/s is briefly described (see also 478 above). The generation of interference and its suppression by suitable design, with or without additional suppressors, is discussed; in particular, radiation from fractional-horse-power motors, fluorescent lamps, h.f. generators and radio and television receivers is considered.

621.396.828 524

A Codan for A.M. Receivers.—J. B. Rudd. (*J. Brit. Instn Radio Engrs*, Nov. 1953, Vol. 13, No. 11, pp. 558–568.) Reprint. See 2132 of 1953.

STATIONS AND COMMUNICATION SYSTEMS

621.396.333 525

Frequency Shift Keying Radio Telegraph Equipment.—D. A. Brooke. (*Telecommun. J. Aust.*, June 1952, Vol. 9, No. 1, pp. 42–51.) A brief survey of the historical development of frequency-shift technique is presented and a description is given of the equipment used on a typical circuit working between Perth and Melbourne; results of some performance tests are discussed.

621.396.5 : 621.396.932 526

Admiralty Radio-Telephone Equipment Type 619.—(*Elect. J.*, 7th Aug. 1953, Vol. 151, No. 6, pp. 419–420.) An outline description is given of the receiver (60 kc/s–32 Mc/s), the h.f. transmitter (1·5–16 Mc/s), the m.f. transmitter (330–550 kc/s) and the power unit for operation from 100–125-V or 200–250-V 50–60-c/s mains. The radiated field from the superheterodyne receiver is $< 0{\cdot}1\ \mu$V/m at a distance of one nautical mile.

621.396.5.029.62 : 621.396.931 527

U.S.W. Radiotelephony for Mobile Services.—H. v. Kobierski. (*Fernmeldetech. Z.*, Aug. 1953, Vol. 6, No. 8, pp. 379–384.) A survey and discussion of specifications for mobile R/T equipment.

621.396.65.029.62 + 621.397.26.029.62 528

Operational and Technical Structure of the Höhbeck V.H.F. Relay Station.—Heuser & Pietz. (See 539.)

621.396.712.3 529

New Studio Installation at Radio Luxemburg.—H. Petzoldt. (*Elektrotech. Z., Edn B*, 21st Aug. 1953, Vol. 5, No. 8, pp. 263–265.) A brief illustrated description of the a.f. equipment and layout.

621.396.721 530

Two-Band Transmitter-Receiver.—G. P. Anderson. (*Wireless World*, Dec. 1953, Vol. 59, No. 12, pp. 593–598.) A detailed description is given of low-power equipment for a fixed or portable station providing telephony and c.w. operation in the 160-m and 80-m bands. Transmitter and receiver are housed in identical boxes 8 in. × 4 in. × 5 in., with a separate unit for power supply. The audio stages of the t.r.f. receiver are used for modulating the transmitter.

621.396.932 + 621.396.963.3 531

Recent Maritime Radio and Radar Developments.—I. F. Byrnes. (*RCA Rev.*, Sept. 1953, Vol. 14, No. 3, pp. 305–317.) An outline description of telegraphy and telephony equipment for cargo and passenger ships complying with F.C.C. requirements, the specifications of the Safety of Life at Sea Convention (London, 1948) and the 1947 Atlantic City Conference Radio Regulations. A surface-search radar with a 16-in. p.p.i. display is also described.

621.396.97.029.6 + 621.397.743.029.6 532

Planning the U.S.W. Broadcasting Network for Sound and Television.—F. Gutzmann, W. Knöpfel & W. Stepp. (*Fernmeldetech. Z.*, Aug. 1953, Vol. 6, No. 8, pp. 353–372.) A survey is made of the development of the transmitter networks in the Federal German Republic before and after the Stockholm Conference [3560 of 1952 (Stepp)]. Frequency allocation, optimum transmitted power, transmitter siting, interference, etc., are discussed. Complete lists are given of the v.h.f. sound and television transmitters, and their geographical position, frequency and radiated power. Field-strength contour and service-area maps are also given. To obtain complete television coverage it will be necessary to provide some u.h.f. transmitters.

SUBSIDIARY APPARATUS

621-526 533

Design Charts for an On/Off Control System.—W. T. Bane. (*Trans. Soc. Instrum. Technol.*, June 1953, Vol. 5, No. 2, pp. 52–70. Discussion, pp. 70–71.) A simple and rapid method is presented for determining the step-function response of an on-off system consisting of a pure time delay (or distance-velocity lag), an exponential time constant and an integration.

621.314.57 534

Self-Excited Two-Phase Thyratron Inverter.—H. Hertwig. (*Electronic Applic. Bull.*, March/April 1953, Vol. 14, Nos. 3/4, pp. 54–58.) Details are given of a unit providing an output of 30 W at 220 V 50 c/s from a 220-V d.c. input.

TELEVISION AND PHOTOTELEGRAPHY

621.397.2 : 621.396.662.029.63 535

The Selection and Amplification of U.H.F. Television Signals.—W. P. Boothroyd & J. Waring. (*Trans. Inst. Radio Engrs*, June 1953, No. PGBTR-3, pp. 5–14.) Maps showing the distribution and coverage of television stations in various parts of the U.S.A. are used to illustrate receiver selectivity problems. The design principles and features of some u.h.f. tuners are described.

621.397.24 : 535.623 536

Color-Television Converter for Cable Networks.—J. G. Reddeck & H. C. Gronberg. (*Electronics*, Nov. 1953, Vol. 26, No. 11, pp. 132–134.) In the N.T.S.C. colour system the colour information is located towards the upper end of the video-signal spectrum, which extends over a band of 4 Mc/s. In order to be able to transmit this information over the long-distance L-1 coaxial cable, which has a bandwidth of about 2·7 Mc/s, the video signal is split into two bands, one covering 0–2 Mc/s and the other covering the colour subcarrier ± 0·3 Mc/s; the latter is heterodyned down close to the former to give a compressed video signal of width 2·7 Mc/s.

621.397.26 : 621.396.65 537

Mobile Outside-Broadcast Decimetre-Wave Equipment for Television Transmission.—H. Röschlau. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 7/8, pp. 144–147.) Equipment for operation on a wavelength of 21 cm is described. The mobile transmitter has an aerial reflector of diameter 1·1 m, giving a beam width of 16°; the stationary receiver has a reflector of diameter 2·4 m, giving a beam width of 12°. The modulation system is d.s.b. a.m. Noise-free pictures have been transmitted over distances > 40 km.

621.397.26 : 621.396.65 538

The Equipment of the Cologne-Frankfurt-Neustadt Decimeter-Wave Television-Relay Link.—O. H. Appelt, K. Christ & K. Schmid. (*Fernmeldetech. Z.*, Aug. 1953, Vol. 6, No. 8, pp. 406–410.) The design principles are noted and brief descriptions are given of the equipment and installations at the relay and terminal stations. The methods used for the determination of receiver sensitivity and signal/noise ratio, and overall distortion, are described.

621.397.26.029.62 + 621.396.65.029.62 **539**

Operational and Technical Structure of the Höhbeck V.H.F. Relay Station.—H. Heuser & H. Pietz. (*Fernmeldetech. Z.*, Sept. 1953, Vol. 6, No. 9, pp. 416–421.) Television, radio programme and R/T relay services are provided for the Berlin-Hamburg v.h.f. link. The equipment, installation and the relay system of operation are described. Frequencies in the 174–216-Mc/s band are used for television and in the 41–68-Mc/s band for sound.

621.397.3 **540**

The Television Picture.—P. Lindner. (*Nachr Tech.*, Aug. 1953, Vol. 3, No. 8, pp. 359–364.) Perspective, contrast, definition, geometry, and the monochrome reproduction of coloured objects, are discussed.

621.397.5 **541**

Amateur Television Progress.—M. Barlow. (*Wireless World*, Dec. 1953, Vol. 59, No. 12, pp. 589–592.) The total number of active amateur experimenters is estimated to be about 500, the number of amateur stations $\gg 25$. Most of the work is done on the 430-Mc/s band. Some details are given of the apparatus used.

621.397.5 : 535.623 **542**

Optimum Utilization of the Radio Frequency Channel for Color Television.—R. D. Kell & A. C. Schroeder. (*Trans. Inst. Radio Engrs*, June 1953, No. PGBTR-3, pp. 33–39.) See 3431 of 1953.

621.397.5 : 535.623 **543**

Transient Considerations in the N.T.S.C. Color System.—B. S. Parmet & L. M. Kaminsky. (*Trans. Inst. Radio Engrs*, June 1953, No. PGBTR-3, pp. 47–67.) A discussion of methods of reducing picture-signal distortion caused by bandwidth limitations. Fourier-integral analysis is used to determine the amount by which a unit step signal is distorted when the bandwidth and rates of cut-off of the filters are adjusted in accordance with N.T.S.C. specifications. Results are shown graphically.

621.397.5 : 535.623 **544**

Technical Signal Specifications Proposed as Standards for Color Television.—(*RCA Rev.*, Sept. 1953, Vol. 14, No. 3, pp. 359–366.) N.T.S.C. revised specifications of July 1953. These embody minor modifications to the February 1953 specifications noted in 3428 of 1953 (Brown & Luck).

621.397.5 : 535.623 **545**

Band-1 Colour Television.—(*Wireless World*, Dec. 1953, Vol. 59, No. 12, p. 599.) A note indicating the advantage from the point of view of compatibility, of transmitting the colour signal by the adjacent-channel system rather than by the N.T.S.C. subcarrier system.

621.397.61 : 621.372.543.2 **546**

High-Frequency-Filter Problems in Television Transmitters.—Burkhardtsmaier. (See 361.)

621.397.611.2 **547**

Image Orthicon Camera Tubes.—G. B. Banks, K. Frank & E. D. Hendry. (*J. Telev. Soc.*, July/Sept. 1953, Vol. 7, No. 3, pp. 92–104.) Detailed description of construction and operation; various manufacturing stages are illustrated.

621.397.611.2 **548**

A Survey of the Development of Television Pickup Devices.—H. A. McGhee. (*J. Brit. Instn Radio Engrs*, Nov. 1953, Vol. 13, No. 11, pp. 543–557.) The survey includes the image dissector and c.r.-tube flying-spot scanner, and camera tubes of both anode-potential-stabilized and cathode-potential-stabilized types. The method of improving the operation of the image iconoscope by flooding the target with low-velocity photoelectrons is described.

621.397.62 **549**

The Design of Television Receivers utilizing Non-synchronous Power.—G. D. Hulst. (*Trans. Inst. Radio Engrs*, June 1953, No. PGBTR-3, pp. 15–24.) An examination of problems involved in the design of sets to receive standard U.S.A. television broadcasts without adverse effects on the picture while using power supplies at frequencies other than 60 c/s. Location of the power transformer and precautions regarding heater wiring are discussed particularly. Details are given of the performance of two commercial receivers.

621.397.62 **550**

German Television Receivers.—H. K. Ibing. (*Z. Ver. dtsch. Ing.*, 11th Aug. 1953, Vol. 95, No. 23, pp. 769–773.) A review of current trends. Features mentioned include provision of high anode voltage, giving brighter pictures; ion traps; ten frequency channels; reduced number of valves; use of Ge diodes. There is little variety as regards i.f. amplifiers, but individuality is shown in the demodulating, filtering and timebase circuits.

621.397.62 **551**

German Television-Receiver Circuits, 1953/54.—W. W. Diefenbach. (*Funk-Technik, Berlin*, Aug. 1953, Vol. 8, No. 16, pp. 485–489.) Features noted in this survey include multichannel reception, larger picture screens, improved sensitivity achieved by use of cascode input circuits, use of Ge diodes, good stability, and improved facilities for servicing.

621.397.62 **552**

The Importance of the D.C. Component.—D. C. Birkinshaw. (*J. Telev. Soc.*, July/Sept. 1953, Vol. 7, No. 3, pp. 105–114.) A description is given of various undesirable effects produced at the receiver if the brightness of the picture is not controlled at the transmitter, i.e. by transmitting the d.c. component; the effects are illustrated by photographs. In some modern receivers the d.c. component is deliberately attenuated to suit other design requirements and to avoid brightness flutter due to passing aircraft; alternative methods of solving these problems are indicated.

621.397.62 : 621.396.662 **553**

A V.H.F.-U.H.F. Television Turret Tuner.—T. Murakami. (*RCA Rev.*, Sept. 1953, Vol. 14, No. 3, pp. 318–340; *Trans. Inst. Radio Engrs*, Oct. 1953, No. PGBTR-4, pp. 38–52.) Channels 2–83 are covered by using six different types of subassembly (channel strip) consisting of the r.f. amplifier, oscillator and mixer circuits. Sixteen channel strips are mounted on a turret-type channel selector and a variable impedance in the anode circuit of the oscillator is used to provide a fine tuning control. The vision i.f. is 45·75 Mc/s, the sound i.f. 41·25 Mc/s. Circuits and performance characteristics are described.

621.397.62 : 621.396.665 **554**

A Keyed Minimum-Signal Detector for Television Receiver Impulse-Noise Immunity.—A. Macovski. (*RCA Rev.*, Sept. 1953, Vol. 14, No. 3, pp. 389–396.) The minimum, instead of the maximum, of a positive synchronizing pulse is used for the synchronizing-signal-separator and the a.g.c. reference voltages. Circuits are described of a minimum-signal detector, separator and a.g.c. systems, diode clipper and noise inverter.

621.397.62 : 621.396.665 555

A Level-setting Sync and Automatic-Gain-Control System for Television Receivers.—E. O. Keizer & M. G. Kroger. (*RCA Rev.*, Sept. 1953, Vol. 14, No. 3, pp. 379–388.) The self-biased synchronizing-signal separator, which charges up on noise pulses, is replaced by a direct-coupled separator, biased by voltage obtained from the i.f. amplifier stage. This circuit also provides the a.g.c. amplification; the a.g.c. voltage is protected from noise pulses by clipping in the separator stage. A television receiver embodying the system is described.

621.397.62.002.2 556

Approach to Mechanized Assembly of Electronic Equipment Applicable to TV Receivers.—R. F. Newton & L. K. Lee. (*Trans. Inst. Radio Engrs*, June 1953, No. PGBTR-3, pp. 25–32.) A study of the immediate possibilities of mechanizing the production of television receivers. Flexibility of operation can be achieved by building up the automatic production line from machine units, individual members of which can be removed as required. Special-purpose machines, such as one for attaching resistors and capacitors, are discussed.

621.397.621 : 621.311.6 557

Ringing-Choke E.H.T. Unit.—D. M. Melluish. (*Wireless World*, Dec. 1953, Vol. 59, No. 12, pp. 603–604.) Description of a circuit suitable for operating a 6-in. c.r. tube, and capable of providing a voltage of 2–3 kV at 250 μA from a 350-V 10-mA supply.

621.397.621.018.75 558

Pulse-Regeneration Equipment for Television Signals.—G. Dröscher. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 7/8, pp. 148–149.) A circuit for use in relaying television is described and illustrated. Synchronizing pulses are separated from the incoming picture signal, the slope of the flanks is increased in two overmodulated amplifier stages, and the pulses are then recombined with the picture signal.

621.397.621.2 : 535.623 559

A Four-Gun Tube for Color Television Receivers.—J. L. Rennick & C. H. Heuer. (*Trans. Inst. Radio Engrs*, June 1953, No. PGBTR-3, pp. 40–46.) The tube is similar to the three-gun aperture-mask type described by Law (844 of 1952), but each group of phosphor dots on the screen includes a fourth dot giving white fluorescence. The signal waveforms required for operating the system are indicated, and the implications of the modification as regards convergence and gamma correction are discussed.

621.397.7 560

New Directional Radio Links and Television Transmitters in the German Democratic Republic.—(*Nachr-Tech.*, Aug. 1953, Vol. 3, No. 8, p. 337.) A note on the inauguration of the Berlin-Leipzig u.h.f. television link and the Leipzig transmitter. The vision transmitter frequency is 59·25 Mc/s (s.s.b. transmission), the f.m. sound transmitter frequency is 65·75 Mc/s.

621.397.7 561

Special Effects for Television Studio Productions.—A. M. Spooner & T. Worswick. (*Proc. Instn elect. Engrs*, Part I, Sept. 1953, Vol. 100, No. 125, pp. 288–296. Discussion, pp. 296–299.) Three methods of producing special effects are described, viz. (*a*) optical-image back projection for providing scenery, (*b*) inlay, in which a picture from one camera is substituted by electronic means for part of the picture from a second camera, (*c*) overlay, in which a result similar to back projection is obtained by electronic means. Advantages and operational difficulties associated with these processes are discussed.

621.397.7 562

The 10-kW Television Transmitter Station on the Feldberg (Taunus).—(*Fernmeldetech. Z.*, Aug. & Sept. 1953, Vol. 6, Nos. 8 & 9, pp. 396–405 & 449–454.) Technical details are given of the sound and vision transmitters and of the slotted-cylinder aerial. A power gain of 12, obtained by feeding the common wide-band aerial via a diplexer, results in effective radiated powers of 36 and 120 kW respectively for sound and vision. The present sound and vision transmission frequencies are 201·75 and 196·25 Mc/s respectively. The account comprises four papers, as follows:—

A. Picture and Sound Transmitters.—E. Heinecke & H. Hornung.
B. Modulation Amplifier and Video Frequency Monitoring Equipment.—R. Urtel & K. Jekelius.
C. Aerial Diplexer and Single-Sideband Filter.—A. Linnebach.
D. Slotted-Cylinder Aerial for the 174–216-Mc/s Television Band.—H. Bosse & W. Crone.

621.397.7 563

The New Television Building in Hamburg-Lokstedt.—W. Nestel. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 7/8, pp. 125–127.) The considerations underlying the structural design and technical equipment of this studio centre are discussed. See also *Funk-Technik, Berlin*, Nov. 1953, Vol. 8, No. 21, pp. 670–671.

621.397.7 564

Architectural Aspects of the New Television Building in Hamburg-Lokstedt.—K. Heinemann & K. Langer. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 7/8, pp. 128–133.)

621.397.7 565

Heating, Ventilating, Air-Conditioning and Refrigerating Installations in the New Television Building at Lokstedt.—O. H. Brandi. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 7/8, pp. 134–135.)

621.397.7 566

The Television Switching Equipment at the Lokstedt Studio.—F. Below. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 7/8, pp. 137–139.) The facilities described correspond to an interim stage in which four studios are available. The circuits from the control cubicles and the film-scanning room are routed via a main control room.

621.397.7 : 534.861.1 567

The Problems of the Acoustics of a Television Studio.—H. Kösters. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 7/8, pp. 135–136.) Acoustics problems associated with the need for frequent changes of scene are discussed.

621.397.712 568

Picture-Mixing Desk for Transmission Truck.—H. Fünfstück. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 7/8, pp. 140–143.) A four-channel mixer is described in which the video-amplitude controls are lever actuated. A black-level-control diode prevents undesirable effects in the amplifier during cross-fades.

621.397.743.029.6 + 621.396.97.029.6 569

Planning the U.S.W. Broadcasting Network for Sound and Television.—Gutzmann, Knöpfel & Stepp. (See 532.)

621.397.8 : 621.397.5 : 535.623 570

A Comparison of Monochrome and Color Television with Reference to Susceptibility to Various Types of Interference.—G. L. Fredendall. (*RCA Rev.*, Sept. 1953, Vol. 14, No. 3, pp. 341–358.) The types of inter-

ference used in this series of subjective tests included co-channel, adjacent-channel, random-noise, sine-wave, impulse-noise and multipath interference. Colour is more susceptible (by 6–8 db) than monochrome to upper-adjacent-channel interference, and slightly more susceptible to some of the other types.

621.397.823 + 621.396.823 **571**

Effect of Radio Interference generated by High-Voltage Lines on the Reception of Broadcast and Television Transmissions.—Passerieux. (See 519.)

621.397.828 **572**

Ignition Interference with Television Reception.—A. H. Ball & W. Nethercot. (*Proc. Instn elect. Engrs*, Part I, Sept. 1953, Vol. 100, No. 125, pp. 299–300.) Oscillograms are shown of the discharge of a typical ignition circuit with and without an interference-suppressing resistor; in the latter case the discharge is oscillatory and the peak value of the current is $\sim$ 220 A; in the former case the discharge is unidirectional and the peak value of the current is 0·8 A. Tests indicate that suppressors have no adverse effect on normal engines under normal operating conditions.

621.397.5 **573**

Television. [Book Review]—F. Kerkhof & W. Werner. Publishers: Cleaver-Hume Press, London, & Elsevier Press, New York, 1952, 434 pp., 50s. (*Nature, Lond.*, 12th Sept. 1953, Vol. 172, No. 4376, pp. 471–472.) "As the first full modern study of the basic aspects of the subject, this work can be recommended with confidence both for general reading and, with the aid of the excellent bibliography provided, as a constant source of reference for more detailed study." For a review of the German edition see 2643 of 1952.

TRANSMISSION

621.396.61.029.55 **574**

A New 5-Kilowatt H.F. Multichannel Transmitter.—F. R. Hill. (*Proc. Instn Radio Engrs, Aust.*, Sept. 1953, Vol. 14, No. 9, pp. 219–227.) A detailed description is given of a telegraphy transmitter comprising four separate crystal-controlled r.f. units, with a r.f. output of 5 kW each at 3–25 Mc/s, a single modulator and a power and power-switching unit. Independent c.w. transmission, or common m.c.w. transmission, on up to four channels is obtained by a simple power-switching operation. With a different modulator the same r.f. units could be used for broadcasting.

621.396.662.6 : 621.396.933 **575**

Increasing Mean Modulation Depth by Peak Speech Clipping.—(*Marconi Rev.*, 4th Quarter 1953, Vol. 16, No. 111, p. 184.) In normal speech the peak power of the average vowel is considerably greater than that of the average consonant, hence a carrier modulated 100% by vowel sounds is modulated much less by consonants. Improved intelligibility is obtained by speech clipping, i.e. reducing this intensity difference before modulation. For 100% modulation by peak vowel sounds, the mean modulation depth is 35% with no clipping, 70% with 12 db of clipping and 95% with 24 db of clipping. The technique is used in air-to-ground communications.

VALVES AND THERMIONICS

537.533 **576**

Field Electron Emission and Gas Adsorption.—F. Kirchner & H. Kirchner. (*Z. angew. Phys.*, Aug. 1953, Vol. 5, No. 8, pp. 281–283.) The variation with temperature of the field emission from a tungsten point with a layer of adsorbed oxygen was investigated experimentally. A critical temperature was found at which an abrupt change occurred in the electron emission; the observed effects indicate that above this temperature the oxygen forms only an incomplete coating.

621.314.632 + 621.314.7] : 537.311.33 **577**

Semiconductor Circuit Elements.—Blakemore, De Barr & Gunn. (See 439.)

621.314.632 : 546.289 **578**

Point-Contact Germanium Rectifiers.—R. T. Lovelock. (*Wireless World*, Nov. & Dec. 1953, Vol. 59, Nos. 11 & 12, pp. 511–514 & 600–602.) A simple exposition of semiconductor theory is given as a basis for a discussion of factors affecting the performance and reliability of Ge rectifiers. The influence of temperature and humidity is examined.

621.385.029.6 : 621.396.822 **579**

Noise in C.W. Magnetrons.—D. Middleton, W. M. Gottschalk & J. B. Wiesner. (*J. appl. Phys.*, Aug. 1953, Vol. 24, No. 8, pp. 1065–1066.) Measurements were made to determine whether the magnetron output should be regarded as carrier plus noise, carrier amplitude-modulated by noise, or carrier phase-modulated by noise; the last of these alternatives appears to fit the experimental results best. The frequency deviations observed could be accounted for by fluctuations in the density of the magnetron space charge due to cathode noise effects or to the presence of gas ions.

621.385.029.63 **580**

Design and Performance of a High-Power Pulsed Klystron.—M. Chodorow, E. L. Ginzton, I. R. Neilsen & S. Sonkin. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, pp. 1584–1602.) Development work at Stanford University on 3-cavity klystrons for operation at 3 Mc/s in the voltage range 100–400 kV, and delivering power of about 20 MW, is discussed. At the voltages used, relativity effects on the electron velocities must be taken into account. Problems connected with the magnetic focusing of the beam, the cathode design, the avoidance of voltage breakdown, and the generation and transformation of the pulses are examined. The collector is shaped so as to receive the beam over a large area, thus ensuring that the temperature rise is not too great. Details are given of the construction of a particular klystron giving pulses of duration 1–2 μs with a beam voltage of 400 kV and a beam current of 250 A. The longest life so far recorded is 200 hours at 17 MW output and $>$ 460 hours at 8 MW output, but it is considered that a life of $>$ 1 000 hours could be attained with an operating voltage of about 300 kV.

621.385.029.63/.64 **581**

Influence of Secondary Electrons on Noise Factor and Stability of Traveling-Wave Tubes.—R. W. Peter & J. A. Ruetz. (*RCA Rev.*, Sept. 1953, Vol. 14, No. 3, pp. 441–452.) The noise factor and stability of the experimental 3-kMc/s travelling-wave valve [277 of 1953 (Peter)] were improved by using a magnetically shielded collector, thus preventing secondary electrons emitted by the collector from reaching the helix. Experimental details are given.

621.385.029.63/.64 **582**

Measurement of the Cross-Sectional Nonuniformity of the Electron Beam in a Helix-Type Travelling-Wave Valve.—H. Schnitger. (*Arch. elekt. Übertragung*, Sept. 1953, Vol. 7, No. 9, pp. 415–420.) As a result of radial components in the initial velocity of the electrons, the beam diameter varies periodically along its length. Using theory given by Wang (1395 of 1950), a relation is established between (*a*) the distance separating successive beam-radius minima (the 'wavelength'), and (*b*) the ratio of maximum to equilibrium radius. The cross-

sectional nonuniformity can then be determined from measurements of this 'wavelength'. The method used is to measure the helix current as a function of the position of a short double coil which is moved coaxially along the valve and whose windings carry equal and opposite currents.

621.385.029.63/.64 **583**

On the Excitation of Different Space-Charge Wave Modes in Travelling-Wave Tubes.—O. E. H. Rydbeck. (*Arch. elekt. Übertragung*, Sept. 1953, Vol. 7, No. 9, pp. 409–414. In English.) Analysis is given for beams of moderate current density. The characteristic equation for the travelling-wave valve is shown to comprise two coupled equations, one associated with the beam and the other with the helix. These equations are used to investigate the excitation of the space-charge waves and their transformation into waves characteristic of travelling-wave valves. All the transformed space-charge waves have practically the same propagation constants, and hence the same gain. Space-charge modes whose wavelength is $\sqrt{2}$ times that for an infinitely wide beam are most easily transformed. It is probable that no transformations of this kind occur at very high beam current density.

621.385.029.63/.64 **584**

Traveling-Wave-Tube Helix Impedance.—Ping King Tien. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, pp. 1617–1623.) Helix impedance K is given by the formula $K = E_z^2(0)/2\beta^2 P$, where $E_z(0)$ is the maximum value of the longitudinal field on the axis, P is the power in the wave carried by the helix, and β the phase constant. The value of K is found by calculation to be smaller for the 'tape-helix' model than for the 'sheath-helix' model, and to decrease as the ratio of helix circumference to free-space wavelength increases. Conditions are analysed for a tape helix surrounded by a dielectric. The theory indicates that the design of travelling-wave valves can be improved (*a*) by means of suitably designed dielectric supports for the helix, and (*b*) by reducing the space-harmonic component fields.

621.385.029.63/.64 **585**

Prediction of Traveling-Wave-Magnetron Frequency Characteristics: Frequency Pushing and Voltage Tuning.—H. W. Welch, Jr. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, pp. 1631–1653.) 'Frequency pushing' is defined as the frequency variation associated with change of anode direct current when the anode voltage is varied, the resonator temperature being held constant. 'Voltage tuning' is defined as the frequency variation associated with change of anode direct voltage when anode direct current, load impedance, magnetic field and resonator temperature are held constant. Formulae are derived expressing the relations involved, based on an approximate determination of the distribution of space charge for high r.f. voltage. Calculated characteristics for typical design parameters are presented. Theoretical and experimental results are compared.

621.385.029.64/.65 **586**

Backward-Wave Tubes.—R. Kompfner & N. T. Williams. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, pp. 1602–1611.) Experiments with travelling-wave valves of the type described by Millman (547 of 1952) show that oscillations can be generated in modes such that r.f. power output is obtained at the gun end of the valve. The first and second spatial-harmonic modes were excited with voltages of 1·6–4 kV and 600–900 V respectively on the electron beam constituting the feedback path; the corresponding wavelength ranges were 6–7·5 mm and 5·9–6·4 mm. A frequency band of 10 kMc/s is thus covered by purely electronic tuning. Power output of about 10 mW was obtained at 6·4 mm λ. The operation of the valves as amplifiers was also studied. Theory is given.

621.385.029.64/.65 : 621.373.423 **587**

Backward-Wave Tube.—H. Heffner. (*Electronics*, Oct. 1953, Vol. 26, No. 10, pp. 135–137.) An explanation is given of the production of the backward wave in a travelling-wave valve, and the conditions for oscillation are indicated. Continuous tuning over a 3 : 1 range is possible.

621.385.029.65 **588**

A Hairpin-Tube Backward-Wave Oscillator.—G. E. Helmke. (*Bell Lab. Rec.*, Aug. 1953, Vol. 31, No. 8, pp. 286–291.) The construction of an experimental valve and, in particular, of the interdigital waveguide section containing the wire loops which resemble a row of hairpins, is described. The frequency of oscillation may be varied between 43 and 63 kMc/s by varying the beam voltage between 500 and 2 500 V.

621.385.032.213.2 **589**

The Emission Constants of Metal Capillary Cathodes.—H. Benda. (*Frequenz*, Aug. 1953, Vol. 7, No. 8, pp. 226–232.) Continuation of work noted in 1155 of 1952 (Katz & Rau). The emission constants of W-$BaCO_3$ + Si cathodes were determined experimentally by measuring the current collected by the metal capillary cathode when connected as anode in relation to a heated counter-electrode; this current depends on the work function of the metal capillary cathode. The arithmetic mean of the work function over a period of aging at about 950°C is 2 eV. The value thus found for the Richardson constant A is of the order of 10^2; the discrepancy between this value and that found by other methods is discussed.

621.385.032.216 **590**

Diffusion of Barium in an Oxide-Coated Cathode.—R. S. Bever. (*J. appl. Phys.*, Aug. 1953, Vol. 24, No. 8, pp. 1008–1010.) Measurements of the diffusion of BaO through activated BaO-SrO cathode coatings, using a technique similar to that described by Redington (432 of 1953), indicated that the law of temperature variation of diffusion was similar to that for Ba in BaO single crystals. The activation energy was 4·1 ± 0·6 eV above 1 280°K and 0·40 ± 0·07 eV below that temperature.

621.385.032.216 **591**

Space-Charge Effect in the Oxide-Cathode Layer: Part 2.—T. Shindo. (*J. phys. Soc. Japan*, July/Aug. 1953, Vol. 8, No. 4, pp. 494–499.) The theory previously given (2082 of 1952) is extended to include the retarding-field region. The emission characteristics for a planar diode are calculated.

621.385.032.216 **592**

A Theoretical Study of the Chemistry of the Oxide Cathode.—E. S. Rittner. (*Philips Res. Rep.*, June 1953, Vol. 8, No. 3, pp. 184–238.) A comprehensive analysis, based on thermochemistry and on the theory of diffusion, is presented. The treatment is based on the assumption that excess Ba is required to activate the coating. Metals with sufficient reducing power to act as activators include Th, Mg, Be, Hf, Sc, Y, Sm, Nd, Pr, La, Zr, U, Al, Si, C and possibly Ti and Ce. The most favourable reaction mechanism for the generation of free Ba is that in which the reaction speed is limited by the rate of diffusion of the activator in the core metal. The free Ba penetrates the oxide crystals by Knudsen vapour flow and volume diffusion, and hence the coating should be porous.

621.385.15 : 621.375.2 **593**

Wide-Band Amplifiers using Secondary-Emission Tubes.—Chandler & Linz. (See 367.)

621.385.15 : 621.385.5 **594**

Electron Multiplier Valve.—A. Lempicki. (*Wireless Engr*, Dec. 1953, Vol. 30, No. 12, pp. 312–317.) The multiplier valve considered is similar in construction to an ordinary r.f. pentode, the multiplier anode being of grid form and occupying the position of the usual suppressor, while the secondary emitter occupies the position of the usual anode; the performance of these two valves is compared. The multiplier type is recommended for wide-band operation, but the overall multiplication factor should be not greater than about 10. Upper frequency limits due to electron transit times in the various sections of the valves are discussed, and noise is considered.

621.385.2 : 621.316.722.1 **595**

Characteristics of the Temperature-Limited Diode Type 29C1.—F. A. Benson & M. S. Seaman. (*Electronic Engng*, Nov. 1953, Vol. 25, No. 309, pp. 462–464.) Static characteristics and long-term test results are given for the diode used in the stabilizer described by Richards (1742 of 1952) and in the differential voltmeter described by Attree (3501 of 1952).

621.385.2.032.21 **596**

Diode Characteristic of a Hollow Cathode.—M. L. Babcock, D. F. Holshouser & H. von Foerster. (*Phys. Rev.*, 1st Aug. 1953, Vol. 91, No. 3, p. 755.) Very much higher currents, particularly for small potentials, are obtained than would be expected from the I/V curve for the equivalent planar diode.

621.385.3 + 621.385.5 **597**

Performance Evaluation of "Special Red" Tubes.—H. J. Prager. (*RCA Rev.*, Sept. 1953, Vol. 14, No. 3, pp. 413–426.) The term 'Special Red' refers to some small receiving-type valves specially selected for industrial applications. The results of life-tests are presented graphically and discussed. Both electrical and mechanical tests were made.

621.385.3 **598**

Variations of Triode Characteristics with Heater Voltage.—F. A. Benson, G. V. G. Lusher & M. S. Seaman. (*Elect. J.*, 14th Aug. 1953, Vol. 151, No. 7, pp. 481–483.) The I_a/V_g characteristic of a triode is modified by a deviation of the filament voltage from normal. It can be expressed by the equation $V_a = r_a\, I_a - \mu V_g - c_2\, r_a$ where r_a is the anode resistance, μ the amplification factor and c_2 a constant which is a function of the applied filament voltage and is important in the design of stabilizers and d.c. amplifiers.

621.385.3 : 621.387 **599**

Control of the Discharge Current in Gas-Filled Valves with Grids by means of Small Alternating Voltages.—A. Székely. (*Acta phys. austriaca*, May 1953, Vol. 7, No. 2, pp. 164–180.) Measurements were made on a Philips Type-4690 triode with the grid connected to the cathode via a high resistance. Application of a small alternating voltage to the grid or anode causes the mean grid potential to become negative with respect to the cathode, thereby raising the ignition voltage. If the circuit is tuned to the applied voltage, this rise in ignition voltage is eliminated. The true variation of ignition voltage with frequency is observed by tuning the circuit to a frequency very different from that of the applied voltage. Results are shown graphically. Application of small alternating voltages can also be used for extinguishing discharges.

621.385.3 : 621.396.662 **600**

The DM 70 and DM 71 Tuning Indicators.—(*Electronic Applic. Bull.*, Jan./Feb. 1953, Vol. 14, Nos. 1/2, pp. 1–11.) These two subminiature valves are identical except for the external connecting arrangements. They have a straight directly heated filament (1·4 V, 0·025 A), a long flat control electrode with an aperture shaped like an exclamation mark, and a luminescent anode beyond the control electrode. Lowering of the potential of the control electrode reduces the length of the luminescent bar. Construction, characteristics and circuits are described. For another account see 3456 of 1953 (White).

621.385.3 + 621.375.2.029.62] : 621.396.822 **601**

Noise Factor of Conventional V.H.F. Amplifiers.—Houlding. (See 369.)

621.385.5 **602**

The EL84 Power Pentode.—P. J. Tijssen. (*Electronic Applic. Bull.*, March/April 1953, Vol. 14, Nos. 3/4, pp. 40–53.) Design, construction and performance details are given of a 12-W output pentode.

621.385.832 : 621.318.572 **603**

The E1T Decade Counter Tube.—(*Electronic Applic. Bull.*, Jan./Feb. 1953, Vol. 14, Nos. 1/2, pp. 13–26.) See 3762 of 1953 (van Overbeek et al.).

621.396.822 **604**

Johnson Noise and Equipartition.—D. A. Bell. (*Proc. phys. Soc.*, 1st Aug. 1953, Vol. 66, No. 404B, pp. 714–715.) Discussion on 2847 of 1953 (Lindsay & Sims).

621.396.822 : [537.311.33 + 621.385.032.21 **605**

Note on Shot Effect in Semi-Conductors and Flicker Effect in Cathodes.—A. van der Ziel. (*Physica*, Aug. 1953, Vol. 19, No. 8, pp. 742–744.) A limitation of the theory previously given (3035 of 1950) is pointed out. It is shown that flicker effect due to emission centres can be treated in the same way as shot noise in semiconductors.

621.396.822 : [621.385.032.21 + 537.311.33 **606**

Theory of the Flicker Effect.—T. B. Tomlinson & W. L. Price. (*J. appl. Phys.*, Aug. 1953, Vol. 24, No. 8, pp. 1063–1065.) Theories on the low-frequency fluctuation of emission current from oxide cathodes and on the similar effect of contact noise in semiconductors are critically reviewed. A modification to Macfarlane's theory (910 of 1951) is discussed which takes account of conditions in retarding-field operation.

621.385.029.6 **607**

Atomic Energy Research Establishment Report A.E.R.E. X/R 608, Mode-Separation Theory for Heavily Strapped Magnetrons. [Book Notice]—A. W. Aikin. Publishers: H.M. Stationery Office, London, 1950, 2s. (*Govt Publ.*, Aug. 1953, p. 20.)

MISCELLANEOUS

6 : 061.4 **608**

The British Instrument Industries Exhibition.—(*Engineer, Lond.*, 3rd–17th July 1953, Vol. 196, Nos. 5084–5086, pp. 20–21, 53–54 & 71–73.) Description of some of the exhibits.

621.38/.39 : 629.13.018 **609**

Aviation Electronics.—A. Van Dyck. (*Proc. Inst. Radio Engrs*, Nov. 1953, Vol. 41, No. 11, pp. 1572–1578.) Special problems introduced by the complexity and unreliability of aircraft electronic apparatus are discussed. The solution depends not only on increasing the reliability of valves and components, but also on improved planning and specifications and on closer cooperation between the electronic engineers and the other personnel concerned.

621.39 : 061.4 **610**

The Leipzig Fair 1953.—(*Nachr Tech.*, Aug. & Sept. 1953, Vol. 3, Nos. 8 & 9, pp. 338–342 & 402–406.) A survey of communication equipment, amplifiers, valves and test equipment exhibited by manufacturers in the German Democratic Republic.

ABSTRACTS and REFERENCES

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The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.213.4 **611**

The Transient Motion of Sound Waves in Tubes.—J. D. Pearson. (*Quart. J. Mech. appl. Math.*, Sept. 1953, Vol. 6, Part 3, pp. 313–335.) Using Heaviside operators, a formula is obtained for the velocity potential in an infinite tube of uniform cross-section, and an asymptotic solution is derived by the method of steepest descent. For a tube of slightly variable cross-section a series solution is obtained. The case of a tube of nearly rectangular cross-section with a longitudinal harmonic distortion is considered in detail.

534.213.4 : 534.61 **612**

Experiments on the Propagation of Plane Sound Waves in Tubes.—D. E. Weston & I. D. Campbell. (*Proc. phys. Soc.*, 1st Sept. 1953, Vol. 66, No. 405B, pp. 769–774.) For measurements in the adiabatic region an acoustic interferometer was used, with a magnetostriction source. Values of attenuation and velocity were determined with tubes of radius 0·013 cm and upward, at frequencies from 10 to 20 kc/s, for various tube materials and gases. The results confirm the modified Kirchhoff's formula. For the transition region between adiabatic and isothermal flow, measurements were made with tubes of radius 0·02 cm. The attenuation results are a little higher than the calculated values, the velocity results are in general agreement with theoretical values.

534.4 : 534.78 **613**

Speech Communication Research.—G. Fant. (*IVA, Stockholm*, 1953, Vol. 24, No. 8, pp. 331–337. In English.) The formation of a speech-communication research group of the Division of Telegraphy and Telephony of the Swedish Royal Institute of Technology is announced and an outline is given of its programme, which covers both engineering and linguistic aspects. Methods for measuring the efficiency of communication systems for handling messages in Swedish are being studied.

534.6 : 534.321.9 **614**

Acoustic-Optical Image Conversion.—G. Spengler. (*NachrTech.*, Sept. 1953, Vol. 3, No. 9, pp. 399–402.) A survey is made of the principal methods used in the visual presentation of sound and ultrasonic fields in solids, liquids and gases. The characteristics of an ideal converter system are discussed and the problem of eliminating spurious effects due to reflections from the converter is considered.

534.614 **615**

The Velocity of Sound in Air at Low Pressures.—D. E. Caro & L. H. Martin. (*Proc. phys. Soc.*, 1st Sept. 1953, Vol. 66, No. 405B, pp. 760–768.) Loudspeakers were arranged at the ends of a tube and measurements were made of the time of transit of a pulse between two microphones mounted about 4 m apart in the wall of the tube, using the two loudspeakers alternately. Frequencies of 250 c/s and 1 kc/s were used. The mean velocity at 20°C is found to be 343·40 ± 0·02 m/s, and is independent of pressure over the range 5–760 mm Hg.

534.846.6 **616**

Investigation of the Acoustics of Large Halls using Models.—R. Lamoral & R. Trembasky. (*Onde élect.*, Oct. 1953, Vol. 33, No. 319, pp. 570–575.) 1-ms pulses of a 30-kc/s signal from an ionophone were transmitted via a tube to a 1/30-scale model. Echoes received on a miniature microphone in the model were recorded by c.r.o.

621.395.61 : 621.375.132 **617**

Note on the Application of Negative Feedback to Electroacoustic Devices.—P. Poincelot. (*Onde élect.*, Oct. 1953, Vol. 33, No. 319, pp. 576–577.) The improvement of the response curve of an electrodynamic microphone on application of negative feedback [1068 of 1950 (Chavasse & Poincelot)] is mentioned as an illustration of the advantages of this technique.

621.395.623.7 **618**

Power Capacity of Loudspeakers.—P. S. Veneklasen. (*Trans. Inst. Radio Engrs*, Sept./Oct. 1953, Vol. AU-1, No. 5, pp. 5–6.) The power-handling capacity is determined by observing the departure from linearity of the acoustic-output/electric-input curves, using octave bands of thermal noise. This method is under consideration for inclusion in a new I.R.E. standard, and comments are invited by the I.R.E. Electroacoustics Committee.

621.395.625.3 : 534.862 : 534.76 **619**

Stereophony in the Cinema.—J. Moir. (*Wireless World*, Jan. 1954, Vol. 60, No. 1, pp. 6–9.) Systems using multiple magnetic sound tracks in conjunction with wide screens are described.

621.395.625.3 : 679.5 **620**

The Manufacture of Magnetic Tapes.—C. P. Fagan. (*Plastics*, Sept. 1953, Vol. 18, No. 194, pp. 323–324.) Materials and processes used in the manufacture of plastic-based tapes are described; advantages of polyester-resin base materials are mentioned.

AERIALS AND TRANSMISSION LINES

621.315.212 : 621.372.2 **621**

Highly Flexible Coaxial Cable with Helical Outer Conductor.—H. Weiss. (*Onde élect.*, Aug./Sept. 1953, Vol. 33, Nos. 317/318, pp. 516–526.) Cable sections suitable for replacing rotary joints are studied, the attenuation being of only secondary importance in this case. The amounts of power transmitted internally and externally are calculated separately; the externally transmitted power becomes zero for a helix pitch of 90° (i.e., ordinary coaxial cable). Dielectric and ohmic losses are discussed and the effect of the distribution of the outer conductor is investigated.

621.315.212 : 621.372.8 **622**

The Transverse Electromagnetic Lecher Wave in Coaxial Cable as a Degenerate Waveguide Wave.—H. Kleinwächter. (*Arch. elekt. Übertragung*, Oct. 1953, Vol. 7, No. 10, pp. 467–469.) The transverse Lecher wave, which is a degenerate E_0 wave, is shown to be the only mode without an axial component which can be propagated in a coaxial cable without attenuation.

621.372.2 **623**

An Investigation of the Characteristics of Cylindrical Surface Waves.—H. M. Barlow & A. E. Karbowiak. (*Proc. Instn elect. Engrs*, Part III, Nov. 1953, Vol. 100, No. 68, pp. 321–328. Discussion, pp. 341–347.) An account is given of an experimental study using a frequency of about 10 kMc/s. For accurate work, the line used was about 4 ft long, short-circuited at both ends by transverse metal plates and excited at resonance, the usual launching horns being dispensed with. Descriptions are given of an axial standing-wave indicator and an instrument for determining the radial field distribution, both designed as far as possible to avoid disturbing the field. Measurements of the decay coefficients of No. 24 s.w.g. Cu wire thickly coated with polythene diverged widely from the values derived from Goubau's approximate theory. On revising the assumptions in the theory, values in agreement with the experimental results were obtained. The surface-wave resonator can also be used for measuring the surface reactance of corrugated surfaces.

621.372.2 **624**

Surface Waves.—H. M. Barlow & A. L. Cullen. (*Proc. Instn elect. Engrs*, Part III, Nov. 1953, Vol. 100, No. 68, pp. 329–341. Discussion, pp. 341–347.) Unified theory is presented for various forms of surface wave, namely the Zenneck wave, the radial cylindrical surface wave, and the Sommerfeld-Goubau or axial cylindrical surface wave. The significance of the Brewster angle of incidence, for which a wave suffers no reflection, is established. The parallel-plate transmission line is discussed and the transition is demonstrated from the TEM wave supported when the plates are close together to the two separate Zenneck waves when the plates are separated by a sufficient distance. The effect of bends in the line is considered and methods of reducing radiation are explained. Launching processes are surveyed with particular reference to the Brewster-angle approach.

621.372.2 : 538.566 **625**

The Types of Wave which may exist near a Guiding Surface.—J. Brown. (*Proc. Instn elect. Engrs*, Part III, Nov. 1953, Vol. 100, No. 68, pp. 363–364.) It is shown theoretically that the waves near a guiding surface can be classified as guided surface waves, evanescent fields or radiation fields. The evanescent fields differ from those in a transmission line or waveguide in that all values of attenuation constant are possible.

621.372.2.012.11 **626**

The Circle Diagram for Reflection Coefficient.—E. Thinius. (*Fernmeldetech. Z.*, Oct. 1953, Vol. 6, No. 10, pp. 468–469.) A chart is presented from which it is possible to obtain the curve for reflection coefficient as a function of frequency.

621.372.8 **627**

The Influence of Bends and Ellipticity on the Attenuation and Propagation Characteristics of the H_{01} Circular Waveguide Mode.—G. D. Sims. (*Proc. Instn elect. Engrs*, Part IV, Oct. 1953, Vol. 100, No. 5, pp. 25–33.) Measurements made with a wave analyser, mainly at a wavelength of 3·2 cm, are reported. Jouguet's theory of propagation in a curved waveguide (3786 of 1947) is discussed and a brief account is given of experiments confirming it. The value of 3·4 db/km obtained for the attenuation in a long closed Cu waveguide, using a multiple-reflection technique, is about three times the theoretical figure; the difference is attributed to losses due to ellipticity and surface roughness.

621.372.9 **628**

Reflection of Electromagnetic Waves at Inhomogeneous Boundary Surfaces with a Periodic Structure Perpendicular to the Electric Vector.—R. Müller. (*Arch. elekt. Übertragung*, Oct. 1953, Vol. 7, No. 10, pp. 492–500.) The particular cases considered mathematically include the incidence of an H_{10} wave in a rectangular waveguide on a slit diaphragm, the incidence of a plane e.m. wave on a stack of matching plates, and the incidence of an H_{10} wave on a discontinuous rectangular coupling section.

621.372.8 **629**

X-Band Rotary Joint.—H. J. Riblet & R. L. Williston. (*Trans. Inst. Radio Engrs*, March 1953, Vol. MTT-1, No. 1, pp. 23–24.) A transition section for operation with high power takes the form of a tapered ridged waveguide; voltage s.w.r. is not greater than 1·02 over an 11% frequency band.

621.396.67 **630**

Some Optical Aspects of Antenna Radiation and Reception.—J. L. Salpeter. (*Philips tech. Commun., Aust.*, 1953, No. 3, pp. 3–10.) Similarities and differences between the e.m. radiations constituting light and those constituting radio waves are outlined; the former are usually noncoherent, the latter coherent. Differences in the design of radiators, reflectors and lenses for light waves and those for radio waves are explained on this basis.

621.396.67 + 621.372.8](083.74) **631**

I.R.E. Standards on Antennas and Waveguides: Definitions of Terms, 1953.—(*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1721–1728.) Standard 53 IRE 2S1.

621.396.676 632

Short Antennas for Mobile Operation.—J. S. Belrose. (*QST*, Sept. 1953, Vol. 37, No. 9, pp. 30–35, 108.) Simple numerical calculations are presented of the radiation resistance, efficiency, effective height, input reactance, etc., of unloaded and loaded vertical aerials near the ground. The results are in good agreement with those determined from field-strength measurements.

621.396.677.3 633

A High-Resolution Aerial System of a New Type.—B. Y. Mills & A. G. Little. (*Aust. J. Phys.*, Sept. 1953, Vol. 6, No. 3, pp. 272–278.) A horizontal aerial system, in the form of crossed arrays consisting of dipoles all of which are parallel to each other, is described. The experimental model, with 120-ft cross arms, operates at 97 Mc/s; the beam width is 8°. Work on a 1°-beam-width system for operation at about 80 Mc/s is in progress. The elementary theory and results of some radio-astronomy measurements are given.

621.396.677.31 634

A Simplified Calculation for Dolph-Tchebycheff Arrays.—G. J. van der Maas. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, p. 1250.) An alternative series is derived which is more suitable for the numerical calculation of the currents in individual elements than that given by Barbiere (1211 of 1952).

621.396.677.71 : 535.42 635

Babinet's Principle and the Slot Antenna.—J. L. Salpeter. (*Philips tech. Commun., Aust.*, 1953, No. 4, pp. 3–15.) Simple theory of the slot aerial is developed from optical diffraction theory. The complementary aspects of dipoles and slot aerials are discussed.

621.396.677.73 636

Calculation of the Gain of Small Horns.—E. H. Braun. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1785–1786.) A simple procedure is given for extending the range of the curves presented by Schelkunoff ('Electromagnetic Waves') to cover horns whose dimensions are small compared with λ.

621.396.677.73 : 621.396.677.8 637

Antennas Fed by Horns.—B. Berkowitz. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1761–1765.) Formulae are derived for the E- and H-plane radiation patterns as functions of illumination taper. The case of a lens or reflector associated with two contiguous horns stacked in either of the principal planes is investigated. By introducing an 'illumination factor', defined in terms of physical dimensions, the following properties are related:—(*a*) loci of half-power beam widths, nulls and side-lobe peaks; (*b*) illumination taper at edge of lens or reflector; (*c*) crossover power; (*d*) spillover power; (*e*) gain referred to the feed horn.

621.396.677.8 : 538.52 : 537.311.5 638

On the Current Induced in a Conducting Ribbon by a Current Filament Parallel to it.—Moullin. (See 704.)

621.396.677.85 639

Artificial Dielectrics having Refractive Indices less than Unity.—J. Brown. (*Proc. Instn elect. Engrs*, Part IV, Oct. 1953, Vol. 100, No. 5, pp. 51–62; Summary, *ibid.*, Part III, Sept. 1953, Vol. 100, No. 67, pp. 319–320.) Two types are considered, the first comprising an array of conducting rods and the second a set of perforated parallel conducting plates. Both are designed for operation with a wave polarized so that its electric field is parallel to the conducting elements. The method of calculating the effective refractive index is indicated. The reflection occurring at the interface between the medium and free space is investigated.

AUTOMATIC COMPUTERS

681.142 640

Programme Design for the C.S.I.R.O. Mark I Computer: Part 1 — Computer Conventions.—T. Pearcey & G. W. Hill. (*Aust. J. Phys.*, Sept. 1953, Vol. 6, No. 3, pp. 316–334.) See also 1050 of 1953 (Beard & Pearcey).

681.142 641

Programme Design for the C.S.I.R.O. Mark I Computer: Part 2 — Programme Techniques.—T. Pearcey & G. W. Hill. (*Aust. J. Phys.*, Sept. 1953, Vol. 6, No. 3, pp. 335–356.) Part 1: 640 above.

681.142 642

Recent Electronic Computers and their Applications.—D. Dainelli & E. Aparo. (*Ricerca sci.*, Sept. 1953, Vol. 23, No. 9, pp. 1528–1549.) Digital computers are described and compared in respect of operating speed and structure.

681.142 643

A Mathematical Basis for an Error Analysis of Differential Analyzers.—K. S. Miller & F. J. Murray. (*J. Math. Phys.*, July/Oct. 1953, Vol. 32, Nos. 2/3, pp. 136–163.)

681.142 644

Analogue Computer for Aircraft Design.—(*Elect. J.*, 18th Sept. 1953, Vol. 151, No. 12, pp. 893–894.) A compact general-purpose instrument designed for economical quantity production.

681.142 : 531.77 645

An Analog-to-Digital Converter.—A. D. Scarbrough. (*Trans. Inst. Radio Engrs*, Sept. 1953, Vol. EC-2, No. 3, pp. 5–7.) A device for giving the angular position of a slowly rotating shaft as a binary number uses a mechanical counter which goes from zero to full capacity during one revolution of the shaft. The counter may comprise a series of cams associated with switches. On application of a reading pulse, the number registered by the counter is made available as a pattern of pulses, the arrangement being suitable as an input device for a digital computer.

681.142 : 621-526 646

Servo Systems for performing Mathematical Operations.—E. Wall. (*Product Engng*, Sept. 1953, Vol. 24, No. 9, pp. 134–140.) By combining servomechanisms with computing systems involving mechanical or electrical analogies, loading effects, which tend to introduce inaccuracies, are eliminated. An outline is given of procedures for addition and subtraction, determination of powers and roots, solution of triangles, and integration.

681.142 : 621.385 647

The Univac Tube Program.—T. D. Hinkelman & M. H. Kraus. (*Trans. Inst. Radio Engrs*, Sept. 1953, Vol. EC-2, No. 3, pp. 8–12.) Account of an integrated programme, starting with the design and initial selection, for ensuring reliable performance of valves in a large-scale computer.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.011.21.012.1 648

Rapid Parallel-Z Calculations.—L. Storch. (*Tele-Tech*, Aug. 1953, Vol. 12, No. 8, pp. 91–93, 193.) Use of a special graph paper with both polar and rectangular coordinates facilitates the calculation. A ruler is the only instrument required in this graphical method.

621.3.012 : [621.318.42 + 621.372.4 **649**

The Calculation of Nonlinear Networks by means of Composite-Straight-Line Characteristics.—A. Hochrainer. (*Elektrotech. u. Maschinenb.*, 1st Sept. 1953, Vol. 70, No. 17, pp. 376–386.) Many circuit problems are simplified by substituting for an actual curved characteristic an approximation built up of rectilinear sections. Use of the method is illustrated by studying the characteristics of iron-cored coils with and without hysteresis, and with and without magnetic bias, and by analysing the free oscillations of a circuit including an iron-cored coil. Emphasis is laid on the point that the actual shape of the nonlinear characteristic is less significant than the simple fact of its deviation from linearity.

621.3.018.78 **650**

Harmonic and Intermodulation Distortion in "Power Law" Devices.—D. G. Lampard. (*Proc. Instn elect. Engrs*, Part IV, Oct. 1953, Vol. 100, No. 5, pp. 3–7.) Explicit expressions are derived for the intermodulation components produced when two sinusoidal voltages are applied simultaneously to a device, such as a diode, whose transfer characteristic can be represented by a simple power-law formula. Results of practical importance in intermodulation-distortion testing are presented graphically.

621.315.332 + 621.316.8 + 621.319.4 **651**

Components for Severe Conditions of Use.—L. Podolsky. (*Onde élect.*, Aug./Sept. 1953, Vol. 33, Nos. 317/318, pp. 510–515.) A discussion of the factors to be considered in the design of capacitors and resistors for use under extreme temperature and humidity conditions, particularly when the components are required to be as small as possible. The use of ceramic-covered wire for the windings of transformers, etc., to withstand high temperatures is mentioned.

621.316.726.029.6 : 621.376.3 **652**

Frequency Discrimination and Stabilization of Square-Wave-Modulated Microwave Transmissions.—C. H. M. Turner. (*Proc. Instn elect. Engrs*, Part III, Nov. 1953, Vol. 100, No. 68, pp. 381–383.) The method described is a modification of that due to Aurell (M.I.T. Technical Report No. 30). The frequency of the oscillations from a reflex klystron is compared with the resonance frequency of a high-Q cavity, and a correction voltage depending on the frequency difference is fed back to the klystron reflector electrode via the modulator, where it is combined with the square-wave modulation voltage. The method of alignment of the microwave circuits is discussed in detail, and the effect of misalignment on the discriminator characteristics is shown.

621.316.86 : 537.312.6 **653**

Properties and Applications of Thermistors.—J. Bleuze. (*Onde élect.*, Aug./Sept. & Oct. 1953, Vol. 33, Nos. 317/318 & 319, pp. 497–509 & 578–590.)

621.316.89.029.5 **654**

Theory of the Boella Effect.—U. Tiberio. (*Alta Frequenza*, June/Aug. 1953, Vol. 22, Nos. 3/4, pp. 184–187.) A discussion of the mechanism causing the drop in the resistance of composition resistors at h.f. (1934 Abstracts, p. 454). A similar variation of resistance with frequency has been observed in electrolytic solutions (Debye-Falkenhagen effect). Comparative measurements were made on 30-kΩ resistors of three different types, namely (*a*) ceramic rod with helical carbon film ('low-resistance type'), (*b*) carbon/resin composition in ceramic case ('high-resistance type'), and (*c*) capillary tube containing a solution of $CuSO_4$ in water (electrolyte type). The Boella effect was most marked in case (*b*). Variation of resistance with electric field strength is also observed. The explanation given is alternative to that of Howe (3226 of 1935).

621.318.4.015.4 **655**

Natural Frequencies of Coils and Windings.—P. A. Abetti & F. J. Maginniss. (*Elect. Engng, N.Y.*, Sept. 1953, Vol. 72, No. 9, p. 781.) Digest only. Calculations for an equivalent circuit consisting of reactors only were made using (*a*) punched-card equipment, (*b*) an a.c.-network analyser. The effect of neglecting the mutual inductance between elements, partly or completely, is shown graphically. Very close agreement with measured natural frequencies was obtained.

621.318.423.011 **656**

Air-Core Coil Design for Crossover Networks.—A. Meyer. (*Trans. Inst. Radio Engrs*, Sept./Oct. 1953, Vol. AU-1, No. 5, pp. 9–11.) Simple analysis is given for determining the correct wire gauge and optimum coil dimensions for specified values of Q and L. Results are shown in charts, and numerical examples illustrate their use.

621.318.435.3.025.3 : 621.375.3 **657**

Three-Phase Transductor Circuits for Magnetic Amplifiers.—A. G. Milnes. (*Proc. Instn elect. Engrs*, Part IV, Oct. 1953, Vol. 100, No. 5, pp. 1–2.) Discussion on 949 of 1953.

621.318.57 : 621.314.7 **658**

Transistors: Theory and Application: Part 10 — Switching Circuits using the Transistor.—A. Coblenz & H. L. Owens. (*Electronics*, Dec. 1953, Vol. 26, No. 12, pp. 186–191.) Counter circuits, relaxation oscillators, etc., using point-contact transistors are described. Part 9: 341 of February.

621.318.57 : 621.314.7 **659**

The Phase-Bistable Transistor Circuit.—R. H. Baker, I. L. Lebow, R. H. Rediker & I. S. Reed. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, p. 1760.) Corrections to paper noted in 3515 of 1953.

621.318.572 : 621.385.832 **660**

The E1T Decade Counter Tube.—(*Electronic Applic. Bull.*, May 1953, Vol. 14, No. 5, pp. 71, 76.) Corrections and addendum to paper noted in 603 of February.

621.372 **661**

A Note on the Network Postulates.—M. G. Arsove. (*J. Math. Phys.*, July/Oct. 1953, Vol. 32, Nos. 2/3, pp. 203–206.) Kirchhoff's law, that the sum of the potential differences about any closed path of branches is zero, is replaced by a version making no explicit references to paths of branches. The resulting law can be interpreted geometrically in terms of orthogonal subspaces of a certain vector space. The network definition given is readily shown to be invariant under changes of basis. The equivalence between the new definition and the classical one is established.

621.372 **662**

The Return-Difference Matrix in Linear Networks.—L. Tasny-Tschiassny. (*Proc. Instn elect. Engrs*, Part IV, Oct. 1953, Vol. 100, No. 5, pp. 39–46.) Bode's concept of the 'return difference' is generalized by replacing the quantities concerned by matrices. A formula for the 'fractionated gain' is derived which is a generalization of Thévenin's theorem. Formulae are also derived for the stability of a circuit, for the variation of its output as a result of imperfections of the circuit elements, and for the input and output impedance. The method is particularly useful for analysing multiple-loop feedback circuits.

621.372 **663**

A Graphical Contribution to the Analysis and Synthesis of Electrical Networks.—O. P. D. Cutteridge. (*Proc. Instn elect. Engrs*, Part IV, Oct. 1953, Vol. 100, No. 5, pp. 83–90. Digest, *ibid.*, Part III, Nov. 1953, Vol. 100, No. 68, pp. 377–379.) "The contribution of the poles and zeros of a network function to the steady-state characteristics at real frequencies is considered by means of vectors, and the connection between attenuation and phase is thereby accentuated. Bode's relation between attenuation and phase in minimum-phase networks is derived by considering the contributions from individual singularities and using a known definite integral in a real variable. Details are derived for the construction of a series of templates, useful for finding pole-zero positions which yield certain attenuation, phase and delay characteristics, and vice versa." The method is illustrated by examples including the estimation of the phase and delay characteristics corresponding to the given attenuation characteristic of a minimum-phase wide-band amplifier.

621.372 **664**

The Relations between Circuit Pass Band and Signal-Build-up Time.—P. Poincelot. (*C. R. Acad. Sci., Paris*, 16th Nov. 1953, Vol. 237, No. 20, pp. 1217–1218.) Two pass-band criteria are discussed, namely (*a*) the bandwidth between the 3-db points and (*b*) the bandwidth defined in terms of spectral distribution of energy. It is shown that these are not uniquely related and that it is not possible to determine the time constant of a circuit solely from a knowledge of its bandwidth.

621.372 : 512.831 **665**

Voltage-Reference Node.—J. Shekel. (*Wireless Engr*, Jan. 1954, Vol. 31, No. 1, pp. 6–10.) Description of a general method of analysing linear networks by nodal analysis without specifying the node to which all voltages are referred; the network can be represented by an indefinite admittance matrix, which can be brought to a definite form by omitting the row and column corresponding to a specified reference node. The method is useful for dealing with valve circuits with earthed-grid or earthed-anode stages or with no earthed electrodes.

621.372.2 : 534.321.9 **666**

Fused-Quartz Ultrasonic Delay-Line Memory.—D. A. Spaeth, T. F. Rogers & S. J. Johnson. (*Electronics*, Dec. 1953, Vol. 26, No. 12, pp. 151–153.) The digit-storage unit described is of the type comprising a slab of fused quartz providing a folded transmission path. Methods are indicated for eliminating spreading of the ultrasonic beam and mode conversion at the reflecting surfaces, thus reducing the intensity of spurious signals. An ultrasonic frequency of 40 Mc/s is used, and pulses with a dynamic range of 40 db can be stored at rates $>5 \times 10^6$/sec.

621.372.412 **667**

Some Notes on the Properties and Manufacture of Piezoelectric Quartz Crystals.—H. L. Downing. (*Proc. Instn Radio Engrs, Aust.*, Oct. 1953, Vol. 14, No. 10, pp. 241–248.) The frequency stability, temperature coefficient and activity of quartz resonators are discussed, and the relation between these properties and the oscillation frequency of a circuit including the crystal is examined. The performance of some typical units is shown graphically.

621.372.413 **668**

Double Compensated Tunable Cavity.—T. S. Saad. (*Trans. Inst. Radio Engrs*, March 1953, Vol. MTT-1, No. 1, pp. 25–28.) Two-frequency temperature compensation of hermetically sealed cavities filled with dry inert gas is described. A typical performance curve is shown.

621.372.5 + 621.375.23 **669**

Differentiating Circuits.—R. L. Ford. (*Electronic Engng*, Dec. 1953, Vol. 25, No. 310, pp. 519–521.) Passive-network and feedback-amplifier types of differentiator are discussed, and the performances of two variants of the latter type are compared.

621.372.5 **670**

Determination of the Input Impedance of Linear Quadripoles by a Graphical Method.—M. Klobe. (*Nachr-Tech.*, Sept. 1953, Vol. 3, No. 9, pp. 421–424.) The data required are the characteristic impedance, the load or terminal impedance and the propagation constant of the quadripole. Two examples are worked out.

621.372.5 **671**

Build-Up Phenomena in Minimum-Phase Networks.—H. Holzwarth. (*Arch. elekt. Übertragung*, Oct. 1953, Vol. 7, No. 10, pp. 473–477.) Wheeler's paired-echo method (3642 of 1939) is used to evaluate the network response to a single pulse and to a step voltage. The method is fundamentally a simplified application of the Fourier integral and is particularly useful for evaluating the distortion with a minimum of computation.

621.372.5 **672**

The Equivalent *Q* of RC Networks.—L. A. Wyatt: D. A. H. Brown: D. W. R. Wheeler. (*Electronic Engng*, Dec. 1953, Vol. 25, No. 310, p. 534.) Further comments on 2919 of 1953 (Brown).

621.372.52 : 621.373.421 **673**

Theory of Twin-T RC Networks and their Application to Oscillators.—A. P. Bolle. (*J. Brit. Instn Radio Engrs*, Dec. 1953, Vol. 13, No. 12, pp. 571–587.) The conditions are established which the circuit elements must satisfy (*a*) for the network to produce infinite attenuation at one frequency, ω_0, and (*b*) for the output to be either in phase or in phase opposition with the input at ω_0 on varying two elements in a particular manner. The slope of the phase/frequency characteristic at $\omega = \omega_0$ is compared with that of a resonant *LC* circuit. One-valve oscillators incorporating such networks are discussed, with particular attention to distortion and stability. Results of measurements on an oscillator are compared with values calculated from theory.

621.372.542.22 : 621.372.412 **674**

Design Procedure for Crystal Lattice Filters.—W. C. Vergara. (*Tele-Tech*, Sept. 1953, Vol. 12, No. 9, pp. 86–87.) The technique of filter design is described and formulae for the electrical and mechanical constants of −18·5° X-cut quartz crystals are given. A bridge network of two divided-electrode crystals operating at 135 kc/s has an image impedance of 425 kΩ.

621.372.542.4.029.3 **675**

The Basic Design of Constant-Resistance Crossovers.—N. H. Crowhurst. (*Audio Engng*, Oct. 1953, Vol. 37, No. 10, pp. 21–22..110.) A simple mathematical analysis of the attenuation and phase characteristics for constant-resistance filters consisting of up to four elements. The frequency response is shown graphically.

621.372.543.2.029.42 **676**

A Band-Pass Filter for Low Frequencies.—A. H. Silcocks: G. W. Morris & P. G. M. Dawe. (*Electronic Engng*, Dec. 1953, Vol. 25, No. 310, pp. 534–535.) Critical comment on 3237 of 1953 and authors' reply.

621.372.543.2.029.63 **677**

Duplexing Filter Design at 2000 Mc/s.—D. R. Crosby. (*Trans. Inst. Radio Engrs*, March 1953, Vol. MTT-1, No. 1, pp. 31–38.) The cavity-resonator-type filters

described are used in commercial communication equipment with transmitter and receiver operating with a frequency separation of 40 Mc/s; both receiving and transmitting filters have a bandwidth of 20 Mc/s.

621.372.56.029.6 **678**

A Comparison of the Properties of Certain Materials used in Low-Power Microwave Attenuators.—F. A. Benson & R. M. Pearson. (*Electronic Engng*, Dec. 1953, Vol. 25, No. 310, pp. 502–505.) Results of measurements on Morganite, antistatic gutta-percha and carbon-loaded bakelite indicate that, if suitably sealed to prevent ingress of moisture, Morganite is the best from the point of view of stability.

621.372.57 : 621.3.018.75 **679**

D.C. Restoring of Variable-Width Rectangular Pulses.—J. van Bladel. (*Electronic Engng*, Dec. 1953, Vol. 25, No. 310, pp. 524–525.) The well-known diode d.c. restoring circuit is discussed; the effect of deviations of source impedance, diode forward resistance and coupling capacitance from their 'ideal' values is investigated. The analysis is illustrated by a practical example.

621.372.57 : 621.385 **680**

Starvation Circuits and their Limitations.—P. J. Erdle. (*Sylvania Technologist*, Oct. 1953, Vol. 6, No. 4, pp. 85–88.) The under-running of valves is deprecated on technical grounds. The valves so operated generally tend to be unstable with variations in the supply voltage and with age.

621.373.4 : 621.316.726 **681**

A Controlled-Frequency Oscillator with Frequency 'Memory'.—J. van Bladel. (*J. sci. Instrum.*, Sept. 1953, Vol. 30, No. 9, pp. 299–301.) An arrangement is described in which a phase-comparison a.f.c. system is used to keep a first oscillator in tune with a second (pilot) oscillator. At a given instant the control loop is broken; thereafter the first oscillator continues to operate at the frequency at the cut-off instant, and subsequent frequency variations of the pilot oscillator are determined from measurements of the phase difference between the two oscillators. A practical circuit which holds frequencies in a band centered on 50 c/s is described.

621.373.4 : 621.385.3 **682**

Oscillator Characteristic Equation.—V. L. Talekar. (*Wireless Engr*, Jan. 1954, Vol. 31, No. 1, pp. 3–6.) The equation for an oscillator circuit using a triode is developed in a form involving the differential coefficients of the dynamic resistance of the triode. Measurements on a Hartley oscillator are reported which are in good agreement with the theoretical results over most of the oscillation characteristic. Particular features of the oscillation characteristics are discussed, and the constants of the triode and the tank circuit are deduced from them.

621.373.4 : 621.396.822 **683**

Effect of Valve Noise on Oscillators.—A. Blaquière. (*C. R. Acad. Sci., Paris*, 23rd Nov. 1953, Vol. 237, No. 21, pp. 1316–1318.) The magnitudes of the valve shot effect and circuit thermal noise in oscillators are compared. When the oscillatory circuit is connected to the grid, the valve noise is relatively negligible; when the oscillatory circuit is connected to the anode, the valve noise preponderates.

621.373.42.029.63 **684**

Tuned Circuit Oscillators at U.H.F.—W. H. Elkin. (*Marconi Instrumentation*, Sept. 1953, Vol. 4, No. 3, pp. 50–54.) The design of a disk-seal-triode oscillator for frequencies up to 1 kMc/s is discussed. The causes of spurious resonance, and their elimination, are considered.

621.373.421 **685**

High-Frequency Resistance-Capacitance Oscillators.—G. W. Holbrook. (*Electronic Engng*, Dec. 1953, Vol. 25, No. 310, pp. 509–511.) The relative merits of shunt-capacitance and shunt-resistance oscillators are discussed. The conditions of oscillation are analysed and the upper frequency limits are examined.

621.373.422/.43 **686**

Sinusoidal and Relaxation Oscillations sustained by Nonlinear Reactances.—R. S. Mackay. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, pp. 1163–1167.) Descriptions are given of various combinations of nonlinear components (e.g., a saturating choke) with linear components (e.g., a capacitor) whereby negative-resistance characteristics can be obtained either of the type in which current is a single-valued function of voltage, or of the type in which voltage is a single-valued function of current. Practical applications are discussed.

621.373.52.029.4 **687**

A Transistor M.C.W. Adapter.—H. V. Braun. (*QST*, Sept. 1953, Vol. 37, No. 9, p. 51.) A miniature keyed a.f. *RC* oscillator is described.

621.375.2.024 : 621.314.58 **688**

Magnetic-Converter D.C. Amplifier.—W. A. Rote. (*Electronics*, Dec. 1953, Vol. 26, No. 12, pp. 170–173.) The d.c. amplifier described comprises a magnetic second-harmonic converter followed by an a.c. amplifier. D.c. signals with power as low as 2×10^{-15}W can be amplified.

621.375.2.029.4.012.3 **689**

Audio Nomographs.—J. F. Sodaro. (*Electronics*, Dec. 1953, Vol. 26, No. 12, pp. 200, 202.) Charts are presented for designing a pentode a.f. amplifier to have desired gain and bandwidth. The method involves the use of separate equivalent circuits for the upper, middle and lower parts of the frequency band.

621.375.232.4.029.63 **690**

Disk-Seal-Triode Amplifiers for Decimetre-Wavelength Radio Links.—A. Egger & G. Pusch. (*Fernmeldetech. Z.*, Oct. 1953, Vol. 6, No. 10, pp. 486–490.) Amplifiers for increasing the transmitter output power and receiver sensitivity in existing links are considered. Grounded-grid circuits are used; simple formulae are derived for gain and bandwidth, giving values in good agreement with experimental results obtained with Type-EC55 and Type-2C39A valves.

621.375.3 **691**

Magnetic Amplifier Circuits and Applications.—R. A. Ramey. (*Elect. Engng, N.Y.*, Sept. 1953, Vol. 72, No. 9, pp. 791–795.) A chronological survey.

621.375.421 : 621.314.7 **692**

The Surface-Barrier Transistor: Part 3 — Circuit Applications of Surface-Barrier Transistors.—J. B. Angell & F. P. Keiper, Jr. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1709–1712.) The operating characteristics of the surface-barrier transistor are discussed and two amplifier circuits are described, namely (*a*) a wide-band low-pass amplifier, and (*b*) a band-pass amplifier for a centre frequency of 30 Mc/s. This type of transistor combines the ability to operate at v.h.f. with the low power consumption of the junction type. Part 2 : 896 below.

631.396.6.002.2 **693**

Mechanized Production of Electronic Equipment.—R. L. Henry & C. C. Rayburn. (*Electronics*, Dec. 1953, Vol. 26, No. 12, pp. 160–164.) An illustrated account is given of production methods developed at the National Bureau of Standards, based on modular design. A steatite wafer $\frac{7}{8}$ in. × $\frac{7}{8}$ in. × $\frac{1}{16}$ in. is used as a basic unit on which components are printed or mounted over printed wiring. Six of these wafers are automatically stacked and connected to form a plug-in unit. Automatic silver-painting, tuning, dip-soldering and testing machines are used. For other accounts see *Tech. News Bull. nat. Bur. Stand.*, Nov. 1953, Vol. 37, No. 11, pp. 161–170 and *Tele-Tech*, Nov. 1953, Vol. 12, No. 11, pp. 70–72..136.

621.396.6.002.2 **694**

Automatic Assembly of Electronic Equipment.—L. K. Lee & C. Brunetti. (*Elect. Mfg.*, July 1953, Vol. 52, No. 1, pp. 97–109..308.) Description of a complete production line for a radar chassis; attaching machines fix components on a printed-circuit base plate.

621.396.6.002.2 : 621.357 : 621.315 **695**

A Flexible Plated Circuit.—E. R. Bowerman & R. F. Walton. (*Radio & Telev. News, Radio-Electronic Engng Section*, Sept. 1953, Vol. 50, No. 3, pp. 12–13.) The 'wiring', initially formed as a 0·001–0·003-in. thick, Cu electrodeposit on a stainless steel plate, is stripped off on a cloth-backed adhesive tape. The complete manufacturing process is described.

GENERAL PHYSICS

537.52 **696**

The Ignition Mechanism of an Electric Gas Discharge in a Transverse Magnetic Field at Pressures of 10^{-1}–10^{-8} Torr.—R. Haefer. (*Acta phys. austriaca*, July 1953, Vol. 7, No. 3, pp. 251–277.) Continuation of work noted in 112 of January. A nonuniform field is obtained by making the radius of the outer cylinder much greater than that of the inner. The ignition characteristic (ignition-voltage/magnetic-induction × electrode separation) obtained by calculation is compared with measurements in Ar; the agreement is good. The ionization coefficient is independent of pressure and the electron replacement coefficient is proportional to pressure. With high voltages and low magnetic fields the electrons are produced mainly by ionic bombardment of the outer cylinder and by ion collisions in the gas; with low voltages and high magnetic fields the electrons are produced mainly by ionic bombardment of the end surfaces. A formula relating the electron replacement coefficient to the ratio between the mean free path and the parameter of the cycloidal electron trajectory gives results in good agreement with those derived from the observed ignition characteristics.

537.52 + 523.72] : 621.383 **697**

Study of High-Frequency Fluctuations from Light Sources using Phototubes and Tuned Radio-Frequency Amplifiers.—K. Landecker & B. J. Robinson. (*Proc. phys. Soc.*, 1st Sept. 1953, Vol. 66, No. 405B, pp. 737–742.) Observations have been made at frequencies up to 95 Mc/s, using two different amplifiers for the ranges below and above 25 Mc/s; the methods of connecting the photocell (R.C.A. Type 919) to the amplifiers are described. The spatial distribution of some types of oscillation along the axis of vapour discharges was investigated. Attempts to observe fluctuations of light from the sun have been made only during 'quiet' periods and have so far yielded negative results.

537.521.7 **698**

Calculation of the Behaviour of Sparks with Resistance and Self-Inductance in the Circuit.—W. Weizel. (*Z. Phys.*, 25th Sept. 1953, Vol. 135, No. 5, pp. 639–657.)

537.521.7 : 681.142 **699**

Analogue-Computer Solution of the Differential Equation for a Spark Gap.—A. Walther & K. J. Lesemann. (*Z. Phys.*, 25th Sept. 1953, Vol. 135, No. 5, pp. 658–664.) The differential equation derived by Weizel (698 above) is easily solved by means of the I.P.M.-Ott integrator.

537.533.8 **700**

Neutralization of Ions and Ionization of Atoms near Metal Surfaces.—L. J. Varnerin, Jr. (*Phys. Rev.*, 15th Aug. 1953, Vol. 91, No. 4, pp. 859–863.) When an ion or an atom approaches a metal surface, neutralization or ionization processes are often possible. The Franck-Condon principle is applied in the determination of the probability of electron transfers. Such transfers are limited to definite ranges of separation from the surface. Most secondary-electron emission is due to an Auger-type process, the contribution due to de-excitation of metastable atoms being very small.

537.56 **701**

Ionization Phenomena in Gases.—A. von Engel & G. Francis. (*Nature, Lond.*, 31st Oct. 1953, Vol. 172, No. 4383, pp. 798–799.) A brief summary of papers presented at the conference held in Oxford in July 1953. The subjects discussed included the spark, arc, glow and h.f. discharges, G-M counters and fundamental processes.

537.562 **702**

Theory of Ionized Media with Distant Boundaries.—M. Hoyaux. (*Rev. gén. Élect.*, Sept. 1953, Vol. 62, No. 9, pp. 421–438.) Continuation of work noted in 381 of 1952. The theory is developed for a configuration in which the electrodes are relatively close while the boundaries are relatively distant. Experimental results confirm the theory. The solution of the differential equations involved, and summarized theory of the potential distribution in the mercury-vapour-rectifier arc are given in appendices.

537.564 **703**

Ionization of Gas by Electrons.—J. K. Knipp, T. Eguchi, M. Ohta & S. Nagata. (*Progr. theor. Phys., Osaka*, July 1953, Vol. 10, No. 1, pp. 24–30.) A statistical analysis is made of the ionization produced by an electron when it is absorbed in hydrogen. Linear integral equations are obtained for the average number and the mean-square fluctuations of the ion pairs. These are evaluated approximately for high values of incident energy.

538.52 : 537.311.5 : 621.396.677.8 **704**

On the Current Induced in a Conducting Ribbon by a Current Filament Parallel to it.—E. B. Moullin. (*Proc. Instn elect. Engrs*, Part III, Nov. 1953, Vol. 100, No. 68, pp. 379–381.) Digest only. The discussion presented makes use of results obtained previously [2723 of 1952 (Moullin & Phillips)] and constitutes one stage in the determination of the diffraction pattern obtained with a system of aerials in the presence of a metal reflector of arbitrary size and shape.

538.56.029.66 : 061.3 **705**

Microwave Optics.—E. Wolf. (*Nature, Lond.*, 3rd Oct. 1953, Vol. 172, No. 4379, pp. 615–616.) Account of a symposium held at McGill University, Montreal, in June 1953.

538.566 : 535.42/.43 **706**

Solution of Electromagnetic Scattering Problems as Power Series in the Ratio (Dimension of Scatterer)/Wavelength.—A. F. Stevenson. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, pp. 1134–1142.) The calculation of the successive terms in the series expressing the scattered field requires only the solution of standard problems in potential theory, together with the evaluation of certain potential integrals. The series can be calculated as far as desired if Laplace's equation can be solved, but the calculation is increasingly complex for successive terms. The special case of scattering by a perfect conductor is also considered and its relation to the problem of diffraction by an aperture in a conducting screen is indicated. Expressions for the distant field are derived.

538.566 : 535.42/.43 **707**

Electromagnetic Scattering by an Ellipsoid in the Third Approximation.—A. F. Stevenson. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, pp. 1143–1151.) The method described in 706 above is used to evaluate the first three terms of the power series in k $(= 2\pi\lambda)$, viz. those in k^2, k^3 and k^4; the term in k^3 vanishes because of the symmetry of the scattering body. The result is expressed as the sum of two elliptic integrals, which are functions of the three principal axes of the ellipsoid. The special cases of the spheroid, perfectly conducting ellipsoid, perfectly conducting disk and of diffraction by an elliptical or circular hole in a perfectly conducting screen are considered.

538.566 : 535.42 **708**

The Vector Wave Function Solution of the Diffraction of Electromagnetic Waves by Circular Disks and Apertures: Part 1 — Oblate Spheroidal Vector Wave Functions. Part 2 — The Diffraction Problems.—C. Flammer. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, pp. 1218–1231.) The vector wave functions considered are the solenoidal solutions of the vector Helmholtz equation. Oblate spheroidal vector wave functions are defined and the expansions for plane polarized waves in terms of them are obtained. A unique solution is obtained for the diffraction by an infinitely thin, perfectly conducting circular disk and by a circular aperture in a plane conducting screen. Two separate groups of these functions are combined to fulfil the condition $E_\phi = 0$ at the rims of the aperture and disk, using the spheroidal coordinate system η, ξ, ϕ.

538.566 : 535.42 **709**

Diffraction of Electromagnetic Waves by an Aperture in a Large Screen.—G. Bekefi. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, pp. 1123–1130.) The approximate solution of the three-dimensional diffraction problem is obtained by using a single component of the Hertz vector. The results are applied to the calculation of the field in the plane of a circular aperture which is large compared with the wavelength. Experiments confirm some of the theoretical results.

538.566 : 535.42 **710**

Diffraction of Electromagnetic Waves by Two Parallel Half-Planes.—B. N. Harden. (*Proc. Instn elect. Engrs*, Part III, Nov. 1953, Vol. 100, No. 68, pp. 348–350.) The field of a plane wave diffracted by the edges of two parallel conducting sheets has been measured close to the diffracting edges for various spacings between the sheets. Experimental results for a spacing of one wavelength are compared with values derived from theory presented by Clemmow (1620 of 1951); the agreement is satisfactory.

537.5 **711**

Electronic and Ionic Impact Phenomena. [Book Review]—H. S. W. Massey & E. H. S. Burhop. Publishers: Clarendon Press, Oxford, 1952, 699 pp., 70s. (*Proc. phys. Soc.*, 1st Sept. 1953, Vol. 66, No. 405A, pp. 851–853.) "... this work is likely to be the standard reference book on the subject for some time to come."

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.5 : 621.396.969.3 **712**

The Radio Echo from the Head of Meteor Trails.—I. C. Browne & T. R. Kaiser. (*J. atmos. terr. Phys.*, Sept. 1953, Vol. 4, Nos. 1/2, pp. 1–4.) Calculations based on diffraction theory give values for the intensity of head echoes in agreement with observation, and also indicate that the ratio between the intensity of the head echo and that of a specularly reflected body echo should be proportional to the radio wavelength and inversely proportional to the difference in range between these echoes. Other anomalous meteor echoes may arise from discontinuities associated with visual flares.

523.53 : 621.396.96 **713**

Radar Determination of the Height of Disappearance of Meteor Trails of Known Radiant.—P. Volmer. (*C. R. Acad. Sci., Paris*, 2nd Nov. 1953, Vol. 237, No. 18, pp. 1065–1067.) Observations were made during the period 11th–13th August 1952 at Meudon, using radar equipment operating on a wavelength of 4 m with a peak power of about 100 kW. Curves representing the time variation of the distance of the theoretically nearest reflection point for various values of the height h at which the trails disappear are shown together with observed nearest reflection points. From the comparison it is deduced that the mean value of h is about 85 km.

523.72 + 523.85] : 621.396.822 **714**

A Symposium on Radio-Astronomy at Jodrell Bank.—R. H. Brown. (*Observatory*, Oct. 1953, Vol. 73, No. 876, pp. 185–198.) Account of the proceedings at the symposium held in July 1953.

523.72 : 621.396.822 **715**

The Distribution of Radio Brightness over the Solar Disk at a Wavelength of 21 Centimetres: Part 2 — The Quiet Sun — One-Dimensional Observations.—W. N. Christiansen & J. A. Warburton. (*Aust. J. Phys.*, Sept. 1953, Vol. 6, No. 3, pp. 262–271.) Assuming the distribution over the solar disk to be circularly symmetrical at this wavelength, the derived radial brightness distribution shows marked limb-brightening. The observed distribution of brightness is in fair agreement with the calculations made from solar models involving a 10^4°K chromosphere and $0{\cdot}3$–$3{\cdot}0 \times 10^6$°K corona, provided that the coronal densities lie between 0·5 and 1·0 times the values usually quoted. Conclusive evidence of a quiet-level r.f. emission was obtained. Part 1: 3209 of 1953.

523.72 : 621.396.822 : 621.396.621 **716**

Two U.H.F. Radiometers (160 Mc/s and 9.350 kMc/s) and Some Radio-Astronomy Applications.—J. Arsac, E. J. Blum, J. H. Lestel & J. L. Steinberg. (*Onde élect.*, Aug./Sept. 1953, Vol. 33, Nos. 317/318, pp. 527–532.) Details are given of improved radio-noise receiving equipment used for continuing the experiments previously reported [3402 of 1953 (Steinberg)]; a power-supply unit stable to within 1 part in 10^{-4} for mains variations of ± 5%, a parabolic-reflector aerial for 9·35 kMc/s, and a dipole aerial array for 160 Mc/s are described. Measurements of the distribution of r.f. brightness over the sun are reported; these include observations made during the solar eclipses of 1951 and 1952.

523.746 717

Progressive Variation of the Shape of the Sunspot Curves.—A. Kiral. (*Naturwissenschaften*, Sept. 1953, Vol. 40, No. 18, pp. 477–478.) Statistical analysis of the sunspot numbers for the 30 eleven-year cycles since 1610 indicates that the asymmetry of the curves is increasing, thus giving support to Gleissberg's theory that there is another cycle with a period of the order of thousands of years.

535.325 : 551.510.52 718

Measurement of Variations in Atmospheric Refractive Index with an Airborne Microwave Refractometer.—H. E. Bussey & G. Birnbaum. (*J. Res. nat. Bur. Stand.*, Oct. 1953, Vol. 51, No. 4, pp. 171–178.) The cavity-resonator refractometer described is essentially the same as that used for previous measurements [2176 of 1951 (Birnbaum)]. Observations were made at heights up to 10 000 ft; examples of strip records obtained are reproduced. The variations were negligible for distances <5 m. Large increases of refractive index were observed on entering cumulus clouds, and intense fluctuations were noted within the clouds.

538.71 719

Airborne Magnetometer for determining All Magnetic Components.—E. O. Schonstedt & H. R. Irons. (*Trans. Amer. geophys. Union*, June 1953, Vol. 34, No. 3, pp. 363–378.) Description of the airborne vector magnetometer Type-1A, an enlarged and modified form of the instrument previously described by Felch et al. (220 of 1948).

550.38 : 551.510.535 : 621.396.11 720

Measurements of the Terrestrial Magnetic Field in the E Layer.—M. Cutolo. (*Nature, Lond.*, 24th Oct. 1953, Vol. 172, No. 4382, pp. 774–775.) Two methods are outlined, both based on determination of the gyro-frequency, which is related by a simple formula to the intensity H of the geomagnetic field in the lower part of the E layer. The first method is based on the double-hump resonance curve (2617 of 1950) and the second is based on the self-demodulation of radio waves at carrier frequencies near gyrofrequency (1758 of 1951). A table is given of values of H determined by these methods in Italy.

550.384 721

A Universal Time Component in Geomagnetic Disturbance.—R. P. W. Lewis & D. H. McIntosh. (*J. atmos. terr. Phys.*, Sept. 1953, Vol. 4, Nos. 1/2, pp. 78–80.) Evidence of a universal time component in the diurnal variation of the geomagnetic disturbance is obtained from an analysis of K-index figures.

550.384 : 621.396.822.029.42 722

Low-Frequency Noise in the Range 0·5–20 c/s.—J. Aarons & M. Henissart. (*Nature, Lond.*, 10th Oct. 1953, Vol. 172, No. 4380, pp. 682–683.) Continuation of previously noted investigations [1628 of 1948 (Menzel & Salisbury) and 3408 of 1948 (Willis)] of the correlation between l.f. e.m. fluctuations and geomagnetic and solar phenomena. A pickup loop with an effective area of 257 m^2 was used with an amplifier having a gain of 160 db and a recorder with chart speed of 1 mm/s. An operating site with low-noise characteristics was chosen. Evidence was obtained of frequent storms in the noise-frequency range studied. A diurnal variation similar to that of the Cheltenham K indices was observed. Analysis indicates significant correlation between the l.f. noise and the 200-Mc/s solar noise observed 29 days earlier.

551.510.53 : 546.214 723

Daily Variation of Amount of Ozone in the Atmosphere.—K. R. Ramanathan & B. V. R. Murthy. (*Nature, Lond.*, 3rd Oct. 1953, Vol. 172, No. 4379, pp. 633–634.) Observations made at Mount Abu and Ahmedabad from Nov. 1952 to April 1953 showed a substantial increase of ozone during night hours, with rapid change-over from day to night values after sunset.

551.510.535 724

An Interpretation of Vertical-Incidence Equivalent-Height versus Time Recordings on 150 kc/s.—K. Lindquist. (*J. atmos. terr. Phys.*, Sept. 1953, Vol. 4, Nos. 1/2, pp. 10–27.) The results of observations made in Pennsylvania, U.S.A., between January 1950 and April 1952 are shown graphically and discussed. One form of echo regularly observed during magnetically disturbed nights is due to one type of sporadic-E stratum. Recorded group and phase heights are compared and the differences compared with those predicted from theory. Results are also given of a preliminary investigation of the effects of solar flares.

551.510.535 725

Investigation of Travelling Disturbances in the Ionosphere by Continuous-Wave Radio.—Y. V. Somayajulu: B. R. Rao & E. B. Rao. (*Nature, Lond.*, 31st Oct. 1953, Vol. 172, No. 4383, pp. 818–820.) Continuous records of the signal intensity of c.w. transmissions over a 640-km path at 9·59 Mc/s and 4·92 Mc/s indicate an F-layer-disturbance velocity of 200–400 m/s. Transmission modes up to $2 \times$ F and $5 \times$ F, respectively, were observed. Simultaneous signal-intensity records of two in-line transmitters 240 km apart, operating at $\sim$ 7·5 Mc/s, showed a constant 8·5-min interval between the corresponding maxima, indicating a disturbance velocity of $\sim$ 230 m/s.

551.510.535 726

The Effect of Soft X-rays from the Solar Corona on the Formation of the Normal Ionospheric E layer.—G. Elwert. (*J. atmos. terr. Phys.*, Sept. 1953, Vol. 4, Nos. 1/2, pp. 68–77. In German.) A calculation has been made previously of the soft X-rays from the solar corona (*Z. Naturf.*, 1952, Vol. 7a, No. 2, pp. 202–204). The results are used to determine the height at which the radiation is absorbed and the number of electrons present at this height under equilibrium conditions. The results agree well with observations of the normal E layer.

551.510.535 727

The Structure of the F Region of the Ionosphere.—A. A. Weiss. (*Aust. J. Phys.*, Sept. 1953, Vol. 6, No. 3, pp. 291–303.) The effects of temperature cycles, of a decay coefficient which is nonuniform with height, and of vertical tidal drifts are considered. The diurnal and seasonal height variations of the F_2 region are explained qualitatively by postulating, in addition to the vertical tides acting on an isothermal Chapman region, a diurnal temperature cycle. This requires a decay coefficient which does not change rapidly with height. On an alternative hypothesis involving discontinuities in the height gradient of the decay coefficient, tidal drifts are still necessary, but a diurnal temperature cycle is not of major importance.

551.510.535 728

World-wide Diurnal Variations in the F_2 Region.—C. W. Allen. (*J. atmos. terr. Phys.*, Sept. 1953, Vol. 4, Nos. 1/2, pp. 53–67.) The chief characteristics of the f_0F_2 variations are described in terms of (*a*) the sunspot-minimum anomaly, (*b*) the sunrise anomaly and (*c*) the diurnal-range anomaly. These anomalies are evaluated quantitatively and extracted from the observations to determine the normal curves. The world distribution of these anomalies is studied and explanations are suggested. Variations of $h'F_2$ do not appear to be related either to the sunspot cycle or to the f_0F_2 variations.

551.510.535 **729**

The Electron Content of the F_2 Layer above Singapore.—B. W. Osborne. (*J. atmos. terr. Phys.*, Sept. 1953, Vol. 4, Nos. 1/2, pp. 82–84.) A comparison of the estimated total ionization present in a unit column below the level of maximum ionization density of the F_2 layer in 1949 and in 1952.

551.510.535 : 550.386 **730**

Geomagnetic and Ionospheric Relationships.—R. P. W. Lewis & D. H. McIntosh. (*J. atmos. terr. Phys.*, Sept. 1953, Vol. 4, Nos. 1/2, pp. 44–52.) The effect of a magnetic 'disturbance' on various geomagnetic and ionospheric parameters is investigated by choosing days on which the K_p sum is markedly different from that of the adjacent days. Most of the parameters show a peak or trough corresponding to that of the disturbance, following it with a delay of 0–18 hours. Particular attention is called to some peculiar seasonal effects, to features of the sporadic E layer at Slough and the vertical movement of the F_2 layer at Huancayo.

551.510.535 : 550.389 **731**

The Effect of the Magnetic Equator on the Ionization of the E_s Layer.—K. Rawer. (*C. R. Acad. Sci., Paris*, 2nd Nov. 1953, Vol. 237, No. 18, pp. 1102–1104.) Observations made at stations at different latitudes in Africa and Europe are analysed. Daytime values of fE_s show a pronounced maximum at the magnetic equator. Observations of the E_s blanketing frequency indicate that the E_s minimum-ionization ceiling is not subject to the effect, which exists only for the ionization clouds.

551.510.535 : 551.55 **732**

Winds in the Ionospheric Regions.—S. Deb. (*J. atmos. terr. Phys.*, Sept. 1953, Vol. 4, Nos. 1/2, pp. 28–43.) A model for the region between 100 and 400 km height is constructed from considerations of the temperature gradients and the observed wind velocities. According to this model, the wind is south-west in the E and F_1 regions and north-east or east in the F_2 region; its velocity increases from 50 m.p.h. at 100 km to 200 m.p.h. at 200 km. There is a seasonal variation in the magnitude of the velocity, but the model does not involve any diurnal or seasonal changes of direction such as have been reported by observers.

551.510.535 : 621.396.11 **733**

Results relating to the Critical Frequency and the Transmission Factor of the Ionosphere F_1 Layer.—Theissen. (See 831.)

551.594.4 : 621.396.11 **734**

A Note on Auroral Interaction.—N. C. Gerson. (*J. atmos. terr. Phys.*, Sept. 1953, Vol. 4, Nos. 1/2, pp. 81–82.) The modulation of a radio wave due to a moving auroral reflecting screen is discussed.

LOCATION AND AIDS TO NAVIGATION

621.396.93 **735**

H.F. Direction Finding.—S. B. Smith & H. G. Hopkins. (*Wireless Engr*, Jan. 1954, Vol. 31, No. 1, pp. 11–14.) A comparison is made of the error components with (*a*) pulse transmissions and (*b*) c.w. transmissions, with particular reference to the performance of Adcock c.r. direction finders operating at frequencies near 8 Mc/s and in the absence of a ground ray. The results presented refer to transmission distances from about 400 to 2 000 km and indicate that pulse operation will normally be at least as accurate as c.w. operation; in the most favourable circumstances for pulse operation (i.e. when a direct first-order echo via the E or E_s layer can be used) the expected ratio of pulse variance to c.w. variance is about 1/3 for single snap bearings.

621.396.93 **736**

An Analysis of Errors in Long-Range Radio Direction-Finder Systems.—J. G. Holbrook. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1747–1749.) A rigorous mathematical analysis is made of errors usually encountered with a newly installed fixed Adcock d.f. station. The effect of variations in the aerial spacing is discussed particularly.

621.396.96 **737**

A Theory of Target Glint or Angular Scintillation in Radar Tracking.—R. H. Delano. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1778–1784.) "A theory is presented to describe the statistical aspects of tracking a complex isolated structure, such as an aircraft or naval vessel, by radar. The results are expressible in simplest form when the target subtends an angle small compared with the beamwidth. Other situations require special consideration and treatment, but can be attacked by the same general methods. However, when the angle subtended by the target is small, a single description applies to all radar tracking systems. An apparent and an effective radar center are defined and their statistical properties derived. Special treatment is given to additional noise arising in conical scanning due to amplitude fluctuations as such. The theory provides information relating to the spectra as well as to the probability densities and r.m.s. values of the pertinent quantities. It must be understood that the theory is approximate, is based on a particular model of the target, and leaves the determination of certain critical parameters to experiment in the case of any particular target."

621.396.96 **738**

The Effective Number of Pulses per Beamwidth for a Scanning Radar.—L. V. Blake. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, p. 1785.) Addendum to paper noted in 2671 of 1953.

621.396.96 : 551.578 **739**

Radar Displays of Atmospheric Precipitation.—B. Birardi. (*Alta Frequenza*, June/Aug. 1953, Vol. 22, Nos. 3/4, pp. 146–160.) Theory of the reflection of radio waves by precipitation is presented and an illustrated description is given of results obtained at the Research Centre for Microwave Physics at Florence. The future research programme is outlined.

621.396.96 : 621.39.001.11 **740**

Radar Detection and Information Theory.—U. Tiberio. (*Alta Frequenza*, June/Aug. 1953, Vol. 22, Nos. 3/4, pp. 161–183.) Radar operation is analysed by a statistical method; errors in range and direction are considered. The common ground between the theory of radar and communication is demonstrated by a discussion of automatic and Doppler-effect radar systems.

621.396.962.3 : 621.396.812.3 **741**

Interpretation of the Fluctuating Echo from Randomly Distributed Scatterers: Part 1.—J. S. Marshall & W. Hitschfeld. (*Canad. J. Phys.*, Sept. 1953, Vol. 31, No. 6, pp. 962–994.) The random fluctuations in the radar echo are investigated statistically and by analogue computation. The results are interpreted in terms of physical methods of reducing their effect. Thus, continuous averaging and limited averaging by the receiver or the A-scope display tube (by superposition of traces) is considered. The precision and the method of measurement of the intensity of the echo from steady and moving targets against a fluctuating noise background are also discussed.

621.396.962.3 : 621.396.812.3 : 551.578 **742**

Interpretation of the Fluctuating Echo from Randomly Distributed Scatterers: Part 2.—P. R. Wallace. (*Canad. J. Phys.*, Sept. 1953, Vol. 31, No. 6, pp. 995–1009.) Echoes from atmospheric precipitation are considered. The method of averaging independent signals is compared with that of continuous averaging. With frequency variation, effectively independent observations from a given region can be obtained. The variation of the signal as the reflection region recedes continuously or as the beam sweeps laterally, is studied. The Markoff method is used throughout. Part 1: 741 above.

621.396.963.3 **743**

Information Cells on Intensity-Modulated C.R.T. Screens.—D. Levine. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1766–1768.) Analysis of screen excitation is based on the assumption that the distribution of the electrons across the beam is Gaussian. It is assumed that two identical radar pulses are just resolvable when they are spaced on the screen so that the crossover of their charge distributions occurs at 40% of the peak intensity; the distance between the 40% points defines the size of the 'information cell'. A specific number of information cells is associated with each type of c.r. tube for a given pulse length and maximum beam current.

621.396.963.8 **744**

Passive Radar Responder.—L. de Magondeaux & R. de Magondeaux. (*Onde élect.*, Aug./Sept. 1953, Vol. 33, Nos. 317/318, pp. 533–539.) The arrangement described consists essentially of a resonator associated with a crystal which, when excited by incident pulses of radiation at a resonance frequency, re-radiates between these pulses the energy abstracted from them. In its simplest form the resonator comprises a $\lambda/2$ dipole with the crystal at its midpoint. Using a quartz crystal with a fundamental frequency of 40 Mc/s, the highest practical operating frequency is the harmonic at 200 Mc/s. Possible applications are discussed under three headings, namely (*a*) those based on the individual character of the response, (*b*) those making use of the time delay of the response, and (*c*) those involving modulation of the response.

621.369.969.11 **745**

Doppler-Effect Omnirange.—P. G. Hansel. (*Proc. Inst. Radio Engrs.*, Dec. 1953, Vol. 41, No. 12, pp. 1750–1756.) An omnirange is described in which the transmitting aerial is caused either to move or to appear to move along a circular path, thus producing low-deviation f.m. by Doppler effect. Deviation expansion and selective degeneration in an a.f.c. circuit are used at the receiver to detect the directional signal in the presence of f.m. noise. Advantages claimed for the system include improved resolution, accuracy and ease of multiplexing.

MATERIALS AND SUBSIDIARY TECHNIQUES

531.787.6/.7 **746**

High-Resolution Micromanometer.—(*Tech. News Bull. nat. Bur. Stand.*, Sept. 1953, Vol. 37, No. 9, pp. 140–142.) An instrument designed by Perls, Kaechale & Goalwin, and capable of measuring differential pressures down to 0·03 μ of Hg, uses a capacitance-type pickup with a thin diaphragm and a capacitance bridge driven by a 500-kc/s oscillator.

533.56 **747**

A Portable High-Vacuum System.—V. C. DeMaria. (*Sylvania Technologist*, Oct. 1953, Vol. 6, No. 4, pp. 96–97.) Outline description of a portable diffusion pump suitable for maintaining pressures down to $\sim 10^{-6}$ mm Hg.

535.215.3 : 538.639 : 546.289 **748**

Photoelectromagnetic and Photodiffusion Effects in Germanium.—T. S. Moss, L. Pincherle & A. M. Woodward. (*Proc. phys. Soc.*, 1st Sept. 1953, Vol. 66, No. 405B, pp. 743–752.) When a slab of Ge is illuminated, a potential gradient is created in the direction of illumination, due to the difference between the electron and hole mobilities (photodiffusion effect). If a magnetic field is applied perpendicular to the direction of illumination, a potential gradient is created in the direction perpendicular to both field and illumination (photoelectromagnetic effect); voltages as great as 0·5 V have been obtained. The saturation value of the photoelectromagnetic voltage provides a convenient measure of the surface recombination velocity. Theory and experimental details are given.

535.37 **749**

Studies on the Concept of Large Activator Centers in Crystal Phosphors.—J. Ewles & N. Lee. (*J. electrochem. Soc.*, Sept. 1953, Vol. 100, No. 9, pp. 392–407.) A study in three parts, under the headings (*a*) dependence of luminescence efficiency on concentration of activator; size of luminescent centres; (*b*) effects of concentration of activator, of temperature, and of flux on the excitation and emission of CaO:Bi phosphors; (*c*) preparation and properties of CaO phosphors with eleven different activators.

535.37 **750**

The Luminescence of Alkaline-Earth Polysulphides.—H. Gobrecht & D. Hahn. (*Z. Phys.*, 25th Sept. 1953, Vol. 135, No. 5, pp. 523–530.)

537.226 : 546.431.82 **751**

The Dielectric Properties of Barium-Titanate Single Crystals in the Region of their Upper Transition Temperature.—L. E. Cross. (*Phil. Mag.*, Oct. 1953, Vol. 44, No. 357, pp. 1161–1170.) A determination was made of the ferroelectric hysteresis and the dielectric constant over the temperature range 20–150°C. The ferroelectric transition in untwinned crystals, at $\sim$ 120°C, is a thermodynamically first order transition; in twinned crystals different regions transform at different temperatures. In untwinned crystals hysteresis is reintroduced at temperatures in a small range above the transition temperature by application of a sufficient electric field. The forms of the hysteresis figures are explained in terms of Devonshire's theory (663 of 1950).

537.226.2 : 537.29 : 621.315.616 **752**

Variations of the Dielectric Constant of some Plastics as a Function of the Electric Field.—G. Mesnard & L. Eyraud. (*C. R. Acad. Sci., Paris*, 30th Nov. 1953, Vol. 237, No. 22, pp. 1406–1407.) Measurements made using a double-heterodyne method are outlined; the material under test constituted the dielectric of a capacitor in a Hartley oscillator circuit, and was subjected to a unidirectional electric field of variable strength. Relative variations of the order of 5×10^{-6} in the value of the dielectric constant could be detected. Results obtained with vinyl chloride, polyethylene, cellophane and other plastics are reported.

537.311.33 **753**

A More Exact Treatment of the Equations describing Dielectric Relaxation and Carrier Motion in Semiconductors.—J. Neilson. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, pp. 1198–1200.) An exact treatment of the linearized equations of hole and electron flow in a

homogeneous semiconductor leads to an expression for the polarization attributable to local variations in conductivity. The corrections to the previously obtained values for the effective mobility and the diffusion coefficient are of the order of τ_r/τ where τ_r is the relaxation time and τ is the lifetime. These corrections are negligible for semiconductors.

537.311.33 : 546.281.26 **754**

The Infrared Absorption Spectrum of Silicon Carbide.—A. K. Ramdas. (*Proc. Indian Acad. Sci. A*, April 1953, Vol. 37, No. 4, pp. 571–577.) The transmission spectra of 12 specimens were studied over the range 1–20 μ. The results are discussed in relation to X-ray determinations of the structure.

537.311.33 : 546.289 **755**

Thermal Acceptors in Vacuum-Heat-Treated Germanium.—S. Mayburg & L. Rotondi. (*Phys. Rev.*, 15th Aug. 1953, Vol. 91, No. 4, pp. 1015–1016.) The Ge single-crystal specimen was heated by passing a current directly through it, and was cooled by radiation. The value found for the concentration of acceptors differed by as much as a factor of 80 from results reported by workers using other methods of vacuum heat treatment. Reasons are advanced for concluding that the observed acceptors are lattice vacancies and not impurity atoms.

537.311.33 : 546.289 **756**

Infrared Absorption of *p*-type Germanium.—W. Kaiser, R. C. Collins & H. Y. Fan. (*Naturwissenschaften*, Sept. 1953, Vol. 40, No. 18, p. 479.) Measurements were made over the wavelength range 1·5–35μ, using specimens with resistivities from 0·04 to about 10 Ω.cm. The characteristic absorption spectrum obtained at room temperature is much more complex than for *n*-type Ge. Weak absorption bands were found at about 2·9μ and 4·5μ, and a strong wide band centred at about 20μ. Modified curves obtained at 5° and 77°K are also shown and discussed.

537.311.33 : 546.824-31 **757**

Electrical Properties of Titanium Dioxide Semiconductors.—R. G. Breckenridge & W. R. Hosler. (*Phys. Rev.*, 15th Aug. 1953, Vol. 91, No. 4, pp. 793–802.) Measurements of resistivity and Hall coefficient in the temperature range − 190°C to + 500°C were made on ceramic and single-crystal rutile specimens with resistivities between 0·1 and 100 Ω.cm. From these measurements, which were made for two different crystal orientations, the variations of electron mobility and charge-carrier concentration with temperature were deduced. The mobility data can be explained in terms of scattering, with the effect of lattice vibration predominant at high temperatures, and that of ionized impurities predominant at lower temperatures. A large effective electron mass is deduced from the mobility values, indicating that the specimens were not degenerate in the temperature range studied, in spite of the large number of charge carriers. The charge-concentration variation found suggests that two types of donor centres, possibly oxygen ion vacancies, are present.

537.311.33 : 548.55 : 546.682.86 **758**

Hall Effect and Conductivity of InSb Single Crystals.—M. Tanenbaum & J. P. Maita. (*Phys. Rev.*, 15th Aug. 1953, Vol. 91, No. 4, pp. 1009–1010.) Measurements on three samples over a range of temperatures are reported, a reversal in sign of the Hall coefficient occurring in two cases, at 155° and 182°K respectively. The deduced value of the energy gap at room temperature is 0·18 eV; this is in agreement with that obtained from infrared-absorption measurements.

537.311.33 : 621.314.7 **759**

The Surface-Barrier Transistor: Part 5 — The Properties of Metal-to-Semiconductor Contacts.—Schwarz & Walsh. (See 895.)

537.312.8 **760**

Galvano-Magnetic Effects at High Frequencies.—B. Donovan & E. H. Sondheimer. (*Proc. phys. Soc.*, 1st Sept. 1953, Vol. 66, No. 405A, pp. 849–851.) A theoretical investigation of the variation of resistivity of a semi-infinite metal with the frequency of an electric field parallel to the surface, in the presence of a magnetic field perpendicular to the surface.

537.533 : 546.78 **761**

Crystallographic Variations of Field Emission from Tungsten.—M. K. Wilkinson. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, pp. 1203–1209.) Emission from a tungsten single crystal was investigated photometrically at pressures around 10^{-12} mm Hg. The experimental method and, in particular, the vacuum technique, are described and the results are tabulated and shown graphically.

537.533.8 : 537.311.33 **762**

Secondary Electron Emission from Impurity Semiconductors.—H. Gobrecht & F. Speer. (*Z. Phys.*, 25th Sept. 1953, Vol. 135, No. 5, pp. 602–614.) Measurements were made on four Ge crystals with different impurities and electrical properties. A monotonic increase up to 7% in the secondary-emission factor was observed to accompany an increase up to $1{\cdot}5 \times 10^3$ in conductivity. This increase is attributed to the increase of impurity concentration accompanying the increased conductivity. The decrease in secondary emission, to be expected as a result of the increased number of charge carriers, is masked. The type of conduction and the nature of the impurity do not affect the secondary emission. Measurements made on Ge and Se evaporated layers with and without impurities confirmed the above results. Secondary-emission curves were also obtained for evaporated layers of the four impurity metals used, namely Ga, Sb, Tl and Bi.

538.221 **763**

On the Nature of Ferromagnetism in Pyrrhotite.—K. Alexopoulos & A. Theodossiou. (*Proc. phys. Soc.*, 1st Sept. 1953, Vol. 66, No. 405B, pp. 753–759.)

538.221 **764**

A Study of Bitter Figures on the (110) Plane of a Single Crystal of Nickel.—L. F. Bates & G. W. Wilson. (*Proc. phys. Soc.*, 1st Sept. 1953, Vol. 66, No. 405A, pp. 819–822.)

538.221 **765**

A Proposed Structure for Certain Domain Configurations on a Single Crystal of Nickel.—G. W. Wilson. (*Proc. phys. Soc.*, 1st Sept. 1953, Vol. 66, No. 405A, pp. 840–841.)

538.221 **766**

Microwave Resonance Absorption in some Ferromagnetic Manganese Compounds.—G. D. Adam & K. J. Standley. (*Proc. phys. Soc.*, 1st Sept. 1953, Vol. 66, No. 405A, pp. 823–835.)

538.221 **767**

Magnetic Viscosity in Platinum Cobalt.—A. W. Simpson & R. H. Tredgold. (*Proc. phys. Soc.*, 1st Sept. 1953, Vol. 66, No. 405B, pp. 805–807.) Experimental results indicate that this alloy obeys the general relation for ferromagnetic materials found by Barbier (1661 of 1950).

538.221 768

Magnets and Magnetism — Recent Developments.—W. Sucksmith. (*Brit. J. appl. Phys.*, Sept. 1953, Vol. 4, No. 9, pp. 257–262.) Ferromagnetic materials, including oxides, are discussed.

538.221 769

Measurement of Permeability Tensor in Ferrites.—J. O. Artman & P. E. Tannenwald. (*Phys. Rev.*, 15th Aug. 1953, Vol. 91, No. 4, pp. 1014–1015.) Preliminary report on an experimental method of determining the off-diagonal tensor components of permeability which involves the splitting of degenerate cavity modes in a magnetic field.

538.221 770

A Comparison of the Powder Patterns on a Sample of Grain-Orientated Silicon-Iron with those obtained on a Single Crystal.—L. F. Bates & A. Hart. (*Proc. phys. Soc.*, 1st Sept. 1953, Vol. 66, No. 405A, pp. 813–818.)

538.221 771

The Permeability of Silicon-Iron.—E. Both. (*Elect. Engng, N.Y.*, Sept. 1953, Vol. 72, No. 9, p. 797.) Digest only. The Si/Fe alloy described has an initial permeability of 1 500 and an incremental permeability value $\sim 0{\cdot}5\%$ per millioersted; the corresponding values for Ni/Fe alloys are 2 000 and 0·2%.

538.247 : 621.318.2 772

Investigations of Aging Processes in Permanent Magnets.—K. J. Kronenberg. (*Z. angew. Phys.*, Sept. 1953, Vol. 5, No. 9, pp. 321–329.) The changes in remanence due to the application of direct and alternating magnetic fields and a variation in the form factor by short-circuiting with a soft iron bar, were investigated experimentally and the results are presented graphically. The magnets investigated were made of tungsten steels, cast and sintered alnic, alnico and iron dust. The remanence of alnic alloys, the most stable magnets, decreased with increase in the number of demagnetizations and with increase in the storage time in the magnetized state. An increase in remanence with storage times was observed in certain cases.

539.23 : 546.87 : 535.215.1 773

The Photoelectric Effect of Thin Bi Films.—D. J. Fourie. (*Phys. Rev.*, 15th Aug. 1953, Vol. 91, No. 4, p. 803.) The variation of photoelectric current observed when d.c. is passed through the film depends on the direction and magnitude of the current but is not a pure heating effect since the passage of a.c. does not cause the same variation.

539.23 : 546.46-31 : 537.533.8 774

The Mechanism of Self-Sustained Electron Emission from Magnesium Oxide.—D. Dobischek, H. Jacobs & J. Freely. (*Phys. Rev.*, 15th Aug. 1953, Vol. 91, No. 4, pp. 804–812.) Continuation of work reported in 998 of 1953 (Jacobs et al.). When higher fields are applied, the secondary-emission current becomes very much larger and increasingly independent of the bombarding current, and, under certain conditions, persists for many hours after the bombarding current has been switched off. This enhanced emission has two components. The first is a true field-enhanced secondary-emission effect similar to that previously described. The second component is a self-sustained electron emission produced by the same type of avalanche effect, except that the internal ionization of the dielectric is initiated by electrons produced from within the material.

546.26 775

The Formation of Black Carbon.—R. O. Grisdale. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, pp. 1082–1091.) Electron-microscope evidence is presented in support of the hypothesis that black carbon resulting from pyrolysis of gaseous hydrocarbons is produced through the intermediate formation of droplets of complex hydrocarbons. It appears that the process is fundamentally similar to that for obtaining carbon by the carbonization of solids.

546.321.85 : 537.226 776

The Properties of Colloidal Ferroelectric Materials: Part 1 — Potassium Phosphate (KH_2PO_4).—C. Jaccard, W. Känzig & M. Peter. (*Helv. phys. Acta*, 15th Sept. 1953, Vol. 26, No. 5, pp. 521–544. In German.) An isolated and nonconducting ferroelectric crystal of approximately spherical shape cannot become polarized spontaneously, if forced to form a single domain, since the energy of the surface charges would exceed the polarization energy. For small crystals, the wall energy prevents splitting into domains; hence a critical size exists, below which spontaneous polarization cannot occur. This was observed in KH_2PO_4 crystals of diameter $<1\,500$ Å embedded in insulating media of dielectric constant $\epsilon \leqslant 5$; crystals of diameter $>4\,000$ Å showed normal ferroelectric properties. The critical diameter decreases with increasing ϵ; in a conducting medium even 500 Å crystals showed normal spontaneous polarization. The anomaly in the dielectric constant of crystals smaller than the critical size at $1{\cdot}0 \pm 0{\cdot}5$°C below the Curie temperature, is probably not due to an antiferroelectric transition.

546.817.231 : 537.312.5 777

"Phosphorescent" Effect in Lead Selenide.—P. A. Lee. (*Canad. J. Phys.*, Sept. 1953, Vol. 31, No. 6, pp. 1023–1024.) Brief report of measurements of the conductivity of a thin layer of PbSe on illumination, at 90°K, by tungsten light. The effect observed is similar to that noted in PbS by Chasmar & Gibson (3156 of 1951).

621.314.634.012.6 778

Contribution to the Knowledge of Dynamic Phenomena in the Selenium Rectifier.—H. Lauckner. (*Z. angew. Phys.*, Sept. 1953, Vol. 5, No. 9, pp. 341–349.) Current creep was investigated experimentally in Se rectifiers with, and without, a lacquer intermediate layer. The results are in agreement with the mobile charge-carrier hypothesis on the assumption that small field changes due to slow ion movements result in large inverse-current changes. The rapid current response to a step voltage in the lacquer-layer type is due to the inhibition of ion movement at the Se grain boundaries.

621.315.6 779

Recent Progress in Dielectrics.—(*Nature, Lond.*, 26th Sept. 1953, Vol. 172, No. 4378, pp. 563–564.) Brief account of the discussions at the meeting of the British Association, Section A, in Liverpool, September 1953.

621.315.61.029.4/.53 780

Maxwell-Wagner Loss and Absorption Currents in Dielectrics.—B. V. Hamon. (*Aust. J. Phys.*, Sept. 1953, Vol. 6, No. 3, pp. 304–315.) The dielectric loss factor of mixtures consisting of a nonpolar base material and a small amount of a slightly conducting solid or liquid 'impurity', was measured at frequencies up to 3 Mc/s. 'Impurities' in the form of small spheres and in the form of a fine powder covering the surfaces of the grains of the base material were studied. The effect of direct and alternating potential gradients on the conductivity and loss factor of the mixtures was also investigated. The results are shown graphically, compared with theoretical results and with published data for practical dielectrics.

621.315.611 781

Experimental Contribution to the Study of the Dielectric Strength of Solid Insulators.—P. Dubois & R. Hérou. (*Rev. gén. Élect.*, Sept. 1953, Vol. 62, No. 9, pp. 438–441.) Report of experiments carried out at the Laboratoire central des Industries électriques to determine the influence of electrode shape and insulator thickness.

621.315.612 782

Phase Transitions in Antiferroelectric $PbHfO_3$.—G. Shirane & R. Pepinsky. (*Phys. Rev.*, 15th Aug. 1953, Vol. 91, No. 4, pp. 812–815.) $PbHfO_3$ is antiferroelectric below 163°C and has an intermediate phase between 163°C and 215°C which is also antiferroelectric, with a different type of dipole arrangement from that of the lowest phase. At 215°C $PbHfO_3$ becomes paraelectric, and its structure changes from the tetragonal to the cubic type.

621.315.612.4 : 621.317.733 783

Some Dielectric Properties of Barium-Strontium Titanate Ceramics at 3 000 Mc/s.—L. Davis, Jr, & L. G. Rubin. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, pp. 1194–1197.) Measurements at 10 kc/s, 500 kc/s and 3 kMc/s indicate that the dielectric constant is independent of frequency at temperatures above the Curie temperature. The effects of electric field strength and temperature on the dielectric constant and the loss tangent were also investigated. The results are shown graphically. The 3-kMc/s bridge is described.

621.315.613.1 784

Synthetic Mica Investigations: Part 1 — A Hot-Pressed Machinable Ceramic Dielectric.—J. E. Comeforo, R. A. Hatch, R. A. Humphrey & W. Eitel. (*J. Amer. ceram. Soc.*, 1st Sept. 1953, Vol. 36, No. 9, pp. 286–294.) The properties and the manufacture of a new ceramic composed entirely of synthetic fluorine-mica are described. Extensive ionic-replacement possibilities permit a large range of variation in the properties, and tables and graphs for the electrical and mechanical characteristics of several types are given. Thus, $BaMg_3Al_2Si_2O_{10}F_2$ has a water absorption $< 0{\cdot}1\%$, density 3·51 g.cm^{-3}, power factor 0·0003, dielectric constant 7·6 and loss factor 0·0022 at 1 Mc/s. The effect of an increase of temperature up to 250°C is small. The transverse strength is $> 8\,000$ lb in^2.

621.315.616 785

Dielectric Properties of Teflon from Room Temperature to 314°C and from Frequencies of 10^2 to 10^5 c/s.—P. Ehrlich. (*J. Res. nat. Bur. Stand.*, Oct. 1953, Vol. 51, No. 4, pp. 185–188.) Measurements indicate that the dielectric constant decreases slightly with increasing temperature and is independent of frequency at all temperatures.

621.318.22 : 538.221 786

The Coercive Force of Magnets moulded from Very Fine Co-Fe Powders.—F. Lihl. (*Acta. phys. austriaca*, July 1953, Vol. 7, No. 3, pp. 239–247.) Continuation of work noted previously (1935 of 1952). Coercive force, remanence and *BH* product increase with Co content; the practically attainable optimum values are not yet reached for 36·4% Co. The positions of the maxima of coercive force and *BH* product, with respect to variations of reduction time and degree depend on the composition; for a given composition the positions of these maxima depend on the powder preparation and moulding processes. Extrapolation to the case of infinitely low density gives lower values of the coercive force than would be expected from Néel's theory, but indicates the highest practically attainable values.

621.791 : 546.621 787

Joining Aluminum to Other Materials.—M. A. Miller. (*Mater. & Meth.*, Sept. 1953, Vol. 38, No. 3, pp. 96–99.) Methods appropriate to various materials, component designs and service requirements are described.

621.92 : 549.514.51 : 621.372.412 788

The Production of Very Thin Quartz Oscillator Plates.—J. E. Thwaites & C. F. Sayers. (*P.O. elect. Engrs' J.*, Oct. 1953, Vol. 46, Part 3, pp. 105–107.) Account of the construction and operation of a machine for lapping plates to a thickness of about 0·055 mm.

666.1 789

Glass in the Electronic Industry.—M. Manners. (*Electronic Engng*, Dec. 1953, Vol. 25, No. 310, pp. 512–516.) The various types of glass available are reviewed and their particular applications indicated, with special reference to problems of sealing. Tables show the composition and properties of some of the most common glasses and some combinations of glass and metal for making seals.

MATHEMATICS

511 : 53 : 621.39 790

Radio Technology and the Theory of Numbers.—B. van der Pol. (*J. Franklin Inst.*, Sept. 1953, Vol. 256, No. 3, p. 265.) Correction to paper noted in 3346 of 1953.

513.761.22 : 621.372 791

Geometric Construction of the Homographic Transformation.—P. Mourmant. (*Onde élect.*, Aug./Sept. 1953, Vol. 33, Nos. 317/318, pp. 540–542.) A discussion of the geometric properties of the homographic transformation $Z = \alpha(\beta + z)/(\gamma + z)$, giving generalized impedance in terms of the complex coefficients α, β and γ and elementary impedance z.

517.6 792

Evaluation of the Integral $\int_0^\infty e^{-u^2 - x/u}\,du$.—M. Abramowitz. (*J. Math. Phys.*, July/Oct. 1953, Vol. 32, Nos. 2/3, pp. 188–192.) The integral studied appears in various physical problems involving particles with Maxwellian distribution of velocities.

518.2 : 517.564 793

Radix Table for obtaining Hyperbolic and Inverse Hyperbolic Functions to Many Places.—H. E. Salzer. (*J. Math. Phys.*, July/Oct. 1953, Vol. 32, Nos. 2/3, pp. 197–202.)

MEASUREMENTS AND TEST GEAR

53.08 : 621.39.001.11 794

The Negentropy Principle of Information.—L. Brillouin. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, pp. 1152–1163.) The statistical definition of information is compared with Boltzmann's formula for entropy. The relations between the information obtained and the cost in entropy (or money) in the measurement of very small quantities are derived and applied to a consideration of the accuracy and efficiency of measurements.

621.317 : 621.396.82 795

Radio Interference.—(*Elect. Rev., Lond.*, 11th Sept. 1953, Vol. 153, No. 11, p. 563.) A note of British Standards on interference measurements and of Electrical Research Association Reports Ref. M/T 116 and 117 describing appropriate measurement equipment.

621.317.089.6 **796**

Practical Calibration Adjustments for Apparatus which Obeys a Theoretical Law Imperfectly.—J. W. Head. (*Electronic Engng*, Dec. 1953, Vol. 25, No. 310, pp. 499–501.) Description of a method devised for calibrating a tone source for which the dial angle ϕ was theoretically related to the frequency f by the formula $\phi = A + B \log_{10} f$. The object was to obtain easily a calibration curve sufficiently smooth and accurate for practical purposes, rather than to find the unique curve satisfying some mathematical criterion of goodness of fit.

621.317.3 : 621.396.822 **797**

Valve and Receiver Noise Measurement at V.H.F.—N. Houlding. (*Wireless Engr*, Jan. 1954, Vol. 31, No. 1, pp. 15–26.) Techniques for the measurement of noise factor, valve noise and other parameters involved in the investigation of receiver noise performance are described. Sources of error, and precautions required to minimize errors, are discussed. Equipment giving improved accuracy is described. Some measurements on noise generators and valve noise are reported.

621.317.32 : 621.385.832 **798**

Measurement of Voltage using a Simple Electron-Beam Valve.—A. Lieb. (*Funk u. Ton*, Sept. 1953, Vol. 7, No. 9, pp. 463–471.) A detailed description is given of a valve of magic-eye type adapted to indicate the adjustment of a variable voltage to a desired setting. Two luminescent streaks, produced by independent beam-forming electrode systems, are brought into coincidence when the adjustment is correct.

621.317.33 : 621.372.413 **799**

Measurement of Resonant-Cavity Characteristics.—G. L. Hall & P. Parzen. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1769–1773.) The system considered is a re-entrant cavity terminating a coaxial line. A method of determining the loaded and unloaded Q and the shunt resistance of the cavity is described, involving measurements of frequency shifts caused by introducing a small obstacle into the cavity. A high-stability high-resolution a.f.c. system for controlling the klystron oscillator is described.

621.317.333.6 : 621.372.8 **800**

A Standard Waveguide Spark Gap.—D. Dettinger & R. D. Wengenroth. (*Trans. Inst. Radio Engrs*, March 1953, Vol. MTT-1, No. 1, pp. 39–48.) Description and comparison of four types of spark gap used for testing the power-handling capacity of waveguides, namely (*a*) resonant-section, (*b*) swayback, (*c*) cylindrical-bump, (*d*) hemispherical-bump types.

621.317.335.3 + 621.317.411 **801**

Optical Methods for Measurement of Complex Dielectric and Magnetic Constants at Centimetre and Millimetre Wavelengths.—T. E. Talpey. (*Onde élect.*, Oct. 1953, Vol. 33, No. 319, pp. 561–569.) Modifications necessary to take account of loss factors in basic formulae relating to transmission and reflection of a plane wave incident on a reflecting plate are discussed. Using formulae derived, permittivity k_ε, permeability k_m and loss angles δ_ε, δ_m can be determined, when losses are small, from (*a*) Brewster angle and transmission and reflection coefficients at this angle of incidence, when the plane of polarization is parallel to the plane of incidence, (*b*) the ratio of the moduli of the reflection coefficients with polarization parallel to and normal to the plane of incidence, (*c*) plate thickness and wavelength. Equipment for measuring these quantities comprises a klystron oscillator with associated wavemeter, attenuator and horn radiator, a receiver with horn attenuator and detector, and a rotatable support for the sample. Experimental results for bakelite, glass, polystyrene and paraffin at λ 8·36 mm are quoted.

621.317.34 : 621.372.8 **802**

Precision Measurement of Waveguide Attenuation.—J. H. Vogelman. (*Electronics*, Dec. 1953, Vol. 26, No. 12, pp. 196–199.) A method of determining attenuation values between 0·01 and 0·5 db, and down to 0·001 db with lower accuracy, is based on standing-wave measurements. The technique is useful for investigating the influence of the waveguide surface condition on the attenuation.

621.317.341.029.62–65 **803**

Audio Modulation Substitution System for Microwave Attenuation Measurements.—J. Korewick. (*Trans. Inst. Radio Engrs*, March 1953, Vol. MTT-1, No. 1, pp. 14–21.) An arrangement for measuring attenuations up to 40 db over the frequency range 240 Mc/s–40 kMc/s uses an audio-modulated klystron oscillator as a stable r.f. source and a barretter as a square-law detector. Attenuation produced in the microwave section by the system under test is compensated by adjustment of a standard attenuator in the audio section, the output level being held constant.

621.317.361.029.64 **804**

Techniques of Frequency Measurement in the Centimetre-Wave Region.—E. G. Hope. (*Proc. Instn elect. Engrs*, Part IV, Oct. 1953, Vol. 100, No. 5, pp. 144–153. Digest, *ibid.*, Part III, Nov. 1953, Vol. 100, No. 68, pp. 383–384.) Methods developed at the National Physical Laboratory and based on the 100-kc/s quartz-crystal standard are discussed. Frequencies up to 50 kMc/s can be measured with an error $<$ 1 part in 10^8. For producing the required standard frequencies in the centimetre-wave range, crystal diodes are used as harmonic generators. The properties of a number of types of crystal diode have been investigated and the optimum values of input power and bias voltage determined. Most types of Si diode and several types of Ge diode are suitable, the Ge types in general requiring less input power for the same harmonic output. On the basis of measurements, an approximate formula is derived for predicting the power in a given harmonic.

621.317.7 : 621.395.822 **805**

A Mains-Operated Psophometer.—F. H. Goldsmith & J. A. Widdicks. (*P.O. elect. Engrs' J.*, Oct. 1953, Vol. 46, Part 3, pp. 112–114.) The psophometer is essentially a valve voltmeter measuring the r.m.s. voltage of a complex a.f. signal and incorporating a frequency-weighting network. An experimental model is described in which the overall error is $< 3\%$.

621.317.723 **806**

Portable Quadrant Electrometer of High Sensitivity.—G. F. Schilling & P. Kreager. (*Rev. sci. Instrum.*, Sept. 1953, Vol. 24, No. 9, pp. 877–878.) Description of an instrument developed in connection with the study of atmospheric electricity.

621.317.73 : 546.28 + 546.289 **807**

Four-Probe Instrument for Resistivity Measurements of Germanium and Silicon.—A. L. MacDonald, J. Soled & C. A. Stearns. (*Rev. sci. Instrum.*, Sept. 1953, Vol. 24, No. 9, pp. 884–885.) A brief description of the construction of the instrument is given.

621.317.733 : 621.315.612.4 **808**

Some Dielectric Properties of Barium-Strontium Titanate Ceramics at 3 000 Mc/s.—Davis & Rubin. (See 783.)

621.317.763.029.64/.65 809

A Microwave Fabry-Perot Interferometer.—J. O. Artman. (*Rev. sci. Instrum.*, Sept. 1953, Vol. 24, No. 9, pp. 873–875.) Details are given of an interferometer for measurements in the wavelength range 5 mm–4 cm, using a movable totally reflecting surface parallel to a fixed partially reflecting surface composed of elements (e.g., metal balls) whose dimensions are much smaller than λ. A magic-T waveguide junction takes the place of the beam-splitting plate of the optical system.

621.317.78.029.6 : 536.62 810

Accurate R.F. Power Measurements.—R. M. Soria & J. G. Krisilas. (*Radio & Telev. News, Radio-Electronic Engng Section*, Sept. 1953, Vol. 50, No. 3, pp. 3–6, 29.) Continuous-flow calorimetric methods are used for r.f. power output measurements, in the range 2 W–5 kW, and for the calibration of input-power indicators. The power-indicator component calibrated is isolated electrically from the thermocouple inserted in it by means of a quarter-wave transformer. Constructional details of the equipment used and performance curves are given.

621.397.621.2.001.4 811

Simple Linearity-Measuring Instrument.—K. G. Beauchamp. (*Wireless World*, Jan. 1954, Vol. 60, No. 1, pp. 36–37.) A device on the lines of a travelling microscope is described for measuring the distance between pairs of parallel bars of a test pattern at different parts of the screen face.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

531.77 : 621.383 812

A Photoelectric Decimal-Coded Shaft Digitizer.—W. H. Libaw & L. J. Craig. (*Trans. Inst. Radio Engrs*, Sept. 1953, Vol. EC-2, No. 3, pp. 1–4.) A device is described for giving an indication of the position of a rotating shaft. Lamps illuminate photocells arranged round the shaft, in accordance with the position of slits in a screen attached to the shaft. Details are given of a decade system.

538.569.2.047 813

Capacity and Conductivity of Body Tissues at Ultrahigh Frequencies.—H. P. Schwan & Kam Li. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1735–1740.) Results of measurements over the frequency range 200–1 000 Mc/s are analysed, and the variations are explained on a biological basis. Temperature variations are also investigated. Measuring technique is described.

621.316.729 814

Cathode-Ray Synchroscope and Automatic Synchronizer.—M. A. H. Ahmed. (*Elect. Engng, N.Y.*, Sept. 1953, Vol. 72, No. 9, p. 808.) Summary only. Two voltages are compared for synchronism by applying them to a c.r. tube so that one produces a circular trace while the other produces radial pips. Automatic synchronization is obtained by using a c.r. tube with a two-electrode target in conjunction with a relay system.

621.317.083.7 : 621.396.91 815

Automatic Radio Equipment for Long-Period Operation for Long-Range Transmissions of Weather Data.—E. Plötze, K. Rawer & E. Stoebe. (*Z. angew. Phys.*, Sept. 1953, Vol. 5, No. 9, pp. 351–359.) Equipment for short-wave meteorological stations for use on sea or land is described. Operational experience with equipment used in the Arctic and the Atlantic regions is discussed.

621.319.339 816

The Design of the Electric Field in a Van de Graaff Generator.—J. W. Boag. (*Proc. Instn elect. Engrs*, Part IV, Oct. 1953, Vol. 100, No. 5, pp. 63–82.)

621.319.339 : [621.398 + 621.317.083.7 817

A Remote Control and Telemetering System for a Van de Graaff Generator.—B. Millar. (*Electronic Engng*, Nov. & Dec. 1953, Vol. 25, Nos. 309 & 310, pp. 446–450 & 506–508.) A system using modulated light beams is described.

621.384.611 818

Vertical Focusing in the Microtron.—J. S. Bell. (*Proc. phys. Soc.*, 1st Sept. 1953, Vol. 66, No. 405B, pp. 802–804.) A theoretical study is made of the vertical focusing oscillations. See also 2090 of 1953 (Henderson et al.).

621.384.612 819

Stability of Orbits in a Strong-Focusing Synchrotron.—S. Lundquist. (*Phys. Rev.*, 15th Aug. 1953, Vol. 91, No. 4, pp. 981–983.)

621.384.612 820

Proton Synchrotron of the University of Birmingham.—(*Nature, Lond.*, 17th Oct. 1953, Vol. 172, No. 4381, pp. 704–706.) Preliminary tests of the machine are reported. See also 700 of 1951 (Hibbard).

621.384.612 821

The Cosmotron — a Review.—M. H. Blewett (Ed.). (*Rev. sci. Instrum.*, Sept. 1953, Vol. 24, No. 9, pp. 725–870.) A series of papers covering all aspects of the Brookhaven proton synchrotron.

621.385.83 : [621.317.329 + 517.944 822

Electrostatic Potential Plotting for Use in Electron-Optical Systems.—Kuo-Chu Ho & Moon. (See 912.)

621.385.833 823

A Method for the Direct Measurement of the Caustic Surfaces of Electron Lenses.—W. Scheffels, M. Hahn & F. Lenz. (*Optik, Stuttgart*, 1953, Vol. 10, No. 9, pp. 455–458.)

621.385.833 824

Correction of Electrostatic Lenses by Departure from Rotational Symmetry.—J. C. Burfoot. (*Proc. phys. Soc.*, 1st Sept. 1953, Vol. 66, No. 405B, pp. 775–792.)

621.385.833 825

Determination of Focal Lengths of Unipotential Lenses by the Rotating-Beam Method.—R. V. Jordan, D. W. Shipley & M. Krawitz. (*Sylvania Technologist*, Oct. 1953, Vol. 6, No. 4, pp. 92–95.) Measurements were made on a three-cylinder unipotential lens modified by inserting apertured diaphragms, by varying the length of the focusing (middle) cylinder, and by varying the spacing between the cylinders. The results are shown graphically.

621.387.424 : 550.8 826

Electronic Equipment used for Geological Research at Depth by Radioactivity Methods.—J. Berbezier. (*Onde élect.*, Oct. 1953, Vol. 33, No. 319, pp. 553–560.) The equipment comprises a G-M-counter probe lowered down the bore-hole on a cable, an automatic depth recorder, pulse integrator and recorder. Records reproduced show the natural and the neutron-induced gamma radiation from different strata at depths down to 680 m.

621.387.424 : 550.8 827

Radioactivity Method of Prospecting for Uranium Ores.—C. Lallemant. (*Onde élect.*, Oct. 1953, Vol. 33, No. 319, pp. 547–552.) Review of the technique, including descriptions and circuit details of French equipment for the detection and measurement of radioactivity.

PROPAGATION OF WAVES

538.566 : 535.42 828

Diffraction of Electromagnetic Waves near the Earth's Surface in an Optically Inhomogeneous Medium.—R. Schachenmeier. (*Arch. elekt. Übertragung*, Oct. 1953, Vol. 7, No. 10, p. 491.) Correction to paper abstracted in 238 of 1952.

621.396.11 : 550.38 : 551.510.535 829

Measurements of the Terrestrial Magnetic Field in the E-Layer.—Cutolo. (See 720.)

621.396.11 : 551.510.535 830

Prediction of Ionospheric Propagation for Distances greater than 10 000 km.—E. Harnischmacher. (*C. R. Acad. Sci., Paris*, 2nd Nov. 1953, Vol. 237, No. 18, pp. 1071–1073.) The method discussed is developed from that previously described by Rawer (199 of 1953) and is based on the assumption that in very-long-distance propagation reflections occur at both F and E layers; the total number of hops is greater than for pure F-layer propagation and the absorption is therefore higher, but the blanketing effect of the E and E_s layers is eliminated. The values of the different possible angles of departure are close together for very-long-distance circuits, and the wave in effect adapts its path to the ionospheric conditions along the route. Experimental results obtained on a 17 000-km path confirm predictions made on this basis.

621.396.11 : 551.510.535 831

Results relating to the Critical Frequency and the Transmission Factor of the Ionosphere F_1 Layer.—E. Theissen. (*C. R. Acad. Sci., Paris*, 2nd Nov. 1953, Vol. 237, No. 18, pp. 1104–1106.) Using values measured at Freiburg in the formula $f_0F_1 = k\cos^n z$ (z is the zenithal angle of the sun, k is the critical frequency for $z = 0$) the mean value of n for the months March–September was found to be 0·22. No seasonal or eleven-yearly variation of its value was found. The value of k depends on the sunspot number. The F_1 transmission factor (M3000) has a diurnal and seasonal variation represented by $M_0\cos^m z$, the value of m being 0·08 ± 0·02. The observations also indicate that the F_1 layer rises as solar activity increases.

621.396.11 : 551.594.5 832

A Note on Auroral Interaction.—N. C. Gerson. (*J. atmos. terr. Phys.*, Sept. 1953, Vol. 4, Nos. 1/2, pp. 81–82.) The modulation of a radio wave due to a moving auroral reflecting screen is discussed.

621.396.81.029.62 : 551.593 833

The Increase of U.S.W. Field Strength due to a Refracting Tropospheric Layer (Inversion).—R. Schachenmeier. (*Arch. elekt. Übertragung*, Oct. 1953, Vol. 7, No. 10, pp. 485–491.) Expressions are derived for the effect of an inversion layer on the field strength at points beyond the horizon. A practical example is worked out. When the receiving aerial is far beyond the horizon and the inversion layer lies below the transmitting aerial, the field strength is increased.

621.396.812.029.62/.63 834

Investigation of the Influence of the Troposphere on the Propagation of Ultra-short Waves.—R. Schachenmeier. (*Arch. elekt. Übertragung*, Oct. 1953, Vol. 7, No. 10, p. 491.) Correction to paper abstracted in 2524 of 1951.

RECEPTION

621.376.233 : 621.314.632 835

Crystal-Mixer Design at Frequencies from 20 000 to 60 000 Mc/s.—Ditchfield. (See 890.)

621.396.621 : 621.314.7 836

Experimental Transistor Receiver.—B. R. Bettridge. (*Wireless World*, Jan. 1954, Vol. 60, No. 1, pp. 2–5.) Two two-transistor circuits for local-station reception are described. The total consumption is 6 mA at 18 V; acceptable volume is obtained with an input of about 20 mW to a sensitive loudspeaker. Reflexing is used to improve sensitivity in the more elaborate circuit.

621.396.621 : 621.396.822 837

First Probability Densities for Receivers with Square-Law Detectors.—R. C. Emerson. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, pp. 1168–1176.) A procedure is indicated for using the Kac-Siegert method (3645 of 1947) in its widest generality without the necessity of finding eigenvalues and without dealing with the characteristic function at all; it involves expanding the density function in an orthonormal series, the coefficients of which are expressed in terms of cumulants, which in turn are obtained from the system kernel. A receiver with Gaussian i.f. and Gaussian a.f. pass characteristics is treated in detail.

621.396.621.57 : 621.376.3 : 631.314.7 838

A Portable Transistor F.M.-Receiver.—R. C. Ballard. (*Tele-Tech*, Aug. 1953, Vol. 12, No. 8, pp. 79, 206–207.) Eleven point-contact Ge transistors and four Ge diodes are used in an experimental receiver giving an overall amplification of 67 db and an undistorted output of 75 mW. The collector-current drain is 60 mA. Circuit details are given.

621.396.812.3 839

Evaluation of Polarization Diversity Performance.—J. L. Glaser & L. P. Faber, Jr. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1774–1778.) Experiments on the reduction of fading effects are reported. Measurements were made on unmodulated signals of frequencies 6·985 and 11·66 Mc/s transmitted from Red Bank, N.J., and received near St. Louis, Mo., separate aerials being used to receive the vertically and horizontally polarized components. The results on 11·66 Mc/s were nearly equal to those which would be produced by independent Rayleigh distributions of signal amplitude for the two components. On 6·985 Mc/s the improvement due to the diversity reception was not so great.

621.396.82 : 621.317 840

Radio Interference.—(See 795.)

621.396.828 : 621.327.43 841

Present Position as regards Suppression of Radio Interference from Fluorescent Lamps.—W. Rüegg. (*Bull. schweiz. elektrotech. Ver.*, 5th Sept. 1953, Vol. 44, No. 18, pp. 804–805. Discussion, pp. 805–807.)

551.594.6 : 621.396.822 842

Radio Research Special Report No. 26. Measurements of Atmospheric Noise at High Frequencies during the years 1945-51. [Book Notice]—F. Horner. Publishers: H.M. Stationery Office, London, 1953, 1s. 9d. (*Govt Publ., Lond.*, Sept. 1953, p. 21.)

STATIONS AND COMMUNICATION SYSTEMS

621.39 : 621.376 843

Applications of Polyphase Modulation in Telecommunications.—S. Silleni. (*Poste e Telecomunicazioni*, Sept. 1953, Vol. 21, No. 9, pp. 403–415.) Some particularly difficult filtering problems can be solved by use of polyphase modulation. The basis of the method is explained and applications are described, including a frequency-shift radiotelegraphy system and transmitters

and receivers for s.s.b. radiotelephony. Phase changers, modulators and mixers are described. The usefulness of the system for economizing on bandwidth is indicated. 45 references.

621.39.001.11 **844**

Introduction to Communication Theory.—E. H. Harwood. (*Trans. S. Afr. Inst. elect. Engrs*, Aug. 1953, Vol. 44, Part 8, pp. 241–250.)

621.39.001.11 **845**

Bits, Language Efficiency and Information Theory.—R. L. Shuey. (*Gen. Elect. Rev.*, Sept. 1953, Vol. 56, No. 5, pp. 15–19.) The basic concepts of communication theory are simply explained.

621.39.001.11 : 519.272 **846**

Correlation and Autocorrelation in Communication Engineering.—W. Meyer-Eppler. (*Arch. elekt. Übertragung*, Oct. & Nov. 1953, Vol. 7, Nos. 10 & 11, pp. 501–504 & 531–536.) The common correlation functions and coefficients are defined and their meanings are explained in physical terms. Numerous applications are noted to problems in physics (e.g., interference) and, in particular, to problems in communication and acoustic engineering, e.g., recognition of signals in noise, objective determination of the acoustic quality of a room, etc. Correlatographs are also discussed. Special devices such as a reading apparatus for the blind and a device for the automatic recognition of the spoken word are mentioned. 46 references.

621.395.43/.44 **847**

Interchannel Interference in Multichannel Carrier Telephone Systems.—S. Dossing. (*Telecommun. J. Aust.*, Oct. 1952, Vol. 9, No. 2, pp. 101–108.) Various forms of interchannel interference are described, and methods of measurement are discussed.

621.395.63 : 621.396.5 **848**

Selective Calling for Radio-Telephone Systems.—J. R. Pollard. (*Electronic Engng*, Dec. 1953, Vol. 25, No. 310, pp. 490–496.) R/T systems consisting of a master station and a number of subsidiary stations are considered, and three alternative circuit arrangements are described for use at subsidiary stations to enable individual, group or general calls to be made. Each arrangement includes a pulse-counting section and a discriminator section; dekatrons and/or cold-cathode trigger triodes are used.

621.396.41 : 621.376.3 **849**

Some Recent Developments in the Multiplexed Transmission of Frequency Modulated Broadcast Signals.—E. H. Armstrong & H. J. Bose. (*Proc. Radio Cl. Amer.*, 1953, Vol. 30, No. 3, pp. 3–13.) An account of the two-channel system operated at Alpine, New Jersey (KE2XCC). The main carrier is frequency-modulated by a subcarrier of frequency 27·5 kc/s; both main carrier and subcarrier are individually frequency-modulated with programme material, the maximum deviation of the former being about 50 kc/s and of the latter 5 kc/s. The maximum modulation frequency is 15 kc/s for the main channel and 7·5 kc/s for the second channel. Cross modulation at the transmitter is avoided by keeping the channels separate up to a stage where the normal circuit requirements call for a bandwidth sufficient to ensure good phase linearity. At the receiver, the first discriminator must be carefully designed to avoid introduction of cross modulation. Performance tests are reported; signals received at a level of $< 10\ \mu$V are intelligible.

621.396.65 : 621.396.41.029.63 **850**

Portable Microwave for Allied Forces in Europe.—M. G. Staton. (*Electronics*, Dec. 1953, Vol. 26, No. 12, pp. 130–134.) The radio relay system described comprises 7 terminal stations and 18 repeater stations, and provides 24 voice channels. The equipment is truck mounted and includes a 58-ft telescoping aerial tower. A f.m. system is used which makes interception difficult.

621.396.65.029.62 **851**

Design Considerations for V.H.F. Link Radio Equipment.—B. Wilson. (*G.E.C. Telecommun.*, Sept. 1953, No. 17, pp. 16–26.) General design of 54–330-Mc/s point-to-point R/T equipment is discussed. Both a.m. and f.m. equipments are considered.

621.396.712 : 621.396.61 **852**

The R.T.F. Transmitting Stations at Sélestat and Allouis L.W.—Gaillard. (See 886.)

621.396.712.029.62 **853**

Radio and Television in [Western] **Germany.**—(*Electronic Engng*, Dec. 1953, Vol. 25, No. 310, pp. 497–499.) Operating frequency and power of the 90 or so v.h.f. stations are tabulated.

621.396.712.3 **854**

The Technical Equipment of the B.B.C. Swansea Studios.—W. J. Stentiford. (*B.B.C. Quart.*, Autumn 1952, Vol. 7, No. 3, pp. 169–173; *Proc. Instn Radio Engrs, Aust.*, Nov. 1953, Vol. 14, No. 11, pp. 270–273.)

621.396.7 **855**

Construction of a Mountain-Top Remote Base Station.—H. V. Church. (*Commun. Engng*, Sept./Oct. 1953, Vol. 13, No. 5, pp. 22–25, 38.) An account of the 250-W station of the Central Vermont Public Service Corporation, installed on Pico Peak, altitude 4 000 ft. The station is remotely controlled by land-line from headquarters 12 miles away. Installation and maintenance problems peculiar to such a location are discussed in detail.

621.396.721 **856**

Two-Band Transmitter-Receiver.—G. P. Anderson. (*Wireless World*, Jan. 1954, Vol. 60, No. 1, p. 37.) Correction to paper noted in 530 of February.

621.396.97 : 621.396.66 **857**

The Automatic Monitoring of Broadcast Programmes.—H. B. Rantzen, F. A. Peachey & C. Gunn-Russell. (*Proc. Instn elect. Engrs*, Part III, Nov. 1953, Vol. 100, No. 68, pp. 372–373.) Discussion on 269 of 1952.

SUBSIDIARY APPARATUS

621-526 **858**

A Nonlinear Servomechanism with Several Independent Variables.—D. Mitrovic. (*C. R. Acad. Sci., Paris*, 16th Nov. 1953, Vol. 237, No. 20, pp. 1209–1211.)

621.311.6 : 539.16 **859**

Radioactive Charging Effects with a Dielectric Medium.—P. Rappaport & E. G. Linder. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, pp. 1110–1114.) The characteristics of a cell consisting of a Sr^{90}-Y^{90} β-ray source, a polystyrene dielectric separator and a collector made of carbon or metal, were investigated. Radioactive current and voltage sources similar to this cell are feasible. The arrangement offers a simple way of studying the effects of radiation on electrical processes in solids.

621.314.634 **860**

The Problem of Heating in the Selenium Rectifier.—W. Stiassny. (*Elektrotech. u. Maschinenb.*, 15th Sept.–15th Oct. 1953, Nos. 18–20, pp. 409–413, 437–441 & 455–

460.) Formulae for the calculation of heat losses are derived. Design for good efficiency and low-temperature rise is discussed in detail, with reference to the operational demands of various applications in power rectification. Typical characteristics curves are given.

621.314.65 **861**

Recent Developments in Ignitrons.—G. M. Zins. (*Electronics*, Dec. 1953, Vol. 26, No. 12, pp. 135–137.)

621.316.722 **862**

Stabilization Problems in Physics.—P. Goudal. (*Cah. Phys.*, Sept. 1953, No. 45, pp. 40–55.) A review of voltage, current, and magnetic-field regulators. The performances of various stabilizing valve circuits and primary regulators are compared, and the importance of good control of filament heating voltages is emphasized. Special problems of stabilization in nuclear physics are mentioned.

621.316.722 : 621.311.6 **863**

A Stabilized D.C. Supply Unit for Output Voltages of 0 to 300 V.—D. J. H. Admiraal. (*Electronic Applic. Bull.*, May 1953, Vol. 14, No. 5, pp. 61–71.) A circuit is described in which the whole of the output-voltage variation is available for controlling the amplifying valve, so that the gain is the same for any output voltage down to zero. The control valve is a pentode whose screen-grid voltage is stabilized by means of a stabilizer tube; the filaments of the amplifying valves, which are also fed from this source, have low consumption. Variation of the output voltage is < 2 mV for mains fluctuations up to 10%.

621.316.722 : 621.387 **864**

Relaxation Oscillations in Voltage-Regulator Tubes.—P. L. Edwards. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1756–1760.) Relaxation oscillations may occur if the regulator tube is shunted by a capacitor and the load line intersects the tube characteristic on the low-current side of the minimum. Methods of modifying the circuit to prevent these oscillations are indicated.

621.316.722.1 : 621.311.6 **865**

An Alternating-Current Stabilizer.—P. A. V. Thomas. (*Electronic Engng*, Dec. 1953, Vol. 25, No. 310, pp. 522–523.) A stabilizer for a valve-heater power supply uses a diode operating with low heater voltage as the error detector and a transductor as the control element. The output voltage can be maintained constant to within $\pm$ 1%.

621.373.4 **866**

Industrial Tube Generator for Low Frequencies.—H. Hertwig & F. N. Wissing. (*Electronic Applic. Bull.*, May 1953, Vol. 14, No. 5, pp. 72–75.) A detailed description is given of a three-phase valve generator suitable for supplying an asynchronous motor at frequencies from 1 to 2 kc/s.

TELEVISION AND PHOTOTELEGRAPHY

621.397.2(41) **867**

Television Service to Belfast.—T. Kilvington. (*P.O. elect. Engrs' J.*, Oct. 1953, Vol. 46, Part 3, pp. 130–133.) "Vision signals for the B.B.C. temporary television transmitter at Belfast are picked up direct from Kirk o' Shotts on 56·75 Mc/s at a receiving site on Black Mountain and passed on a carrier of 6·12 Mc/s over about a mile of coaxial cable to the temporary transmitter site in Glencairn, whence they are re-broadcast on a carrier of 45 Mc/s."

621.397.26 : 621.385.029.63 : 621.376.3 **868**

A 50-Watt F.M. Magnetron for Relay Service.—Kennedy. (See 904.)

621.397.5 : 535.623 **869**

The American Television Scene.—M. J. L. Pulling. (*Wireless World*, Jan. 1954, Vol. 60, No. 1, pp. 13–15.) Impressions reported by a visiting British engineer, particularly of the colour-television demonstration staged on 15th October 1953.

621.397.5 : 535.623 **870**

Compatible Colour Television.—D. A. Bell. (*Wireless World*, Jan. 1954, Vol. 60, No. 1, p. 31.) Sideband interference problems involved in using the N.T.S.C. colour-subcarrier system with the British television system are discussed; the narrower video-frequency band is the most serious difficulty.

621.397.5 : 535.623 **871**

The N.T.S.C. Color-Television Standards.—D. G. Fink. (*Electronics*, Dec. 1953, Vol. 26, No. 12, pp. 138–150.) The final N.T.S.C. compatible-colour signal specifications, presented in July 1953, are discussed in detail.

621.397.5 : 621.39.001.11 **872**

The Impact of Information Theory on Television.—D. A. Bell. (*J. Brit. Instn Radio Engrs*, Dec. 1953, Vol. 13, No. 12, pp. 590–591.) Discussion on 3731 of 1953.

621.397.5 (41) **873**

An Outline of the British Television System: Part 2 — Transmitting the Picture Waveform.—D. Wray. (*P.O. elect. Engrs' J.*, Oct. 1953, Vol. 46, Part 3, pp. 123–128.) The five-channel vestigial-sideband broadcasting system is outlined; operating frequency and power are tabulated for the ten stations. The transmitters are connected to the London studios by cable and radio links. Outside-broadcast material is transmitted over short distances either by coaxial or balanced-pair cable, portable radio links, or ordinary telephone pairs. Part 1: 271 of January.

621.397.611 : 621.375.232 **874**

Modified Preamplifier improves Movie Telecasts.—K. B. Benson. (*Electronics*, Dec. 1953, Vol. 26, No. 12, pp. 166–169.) A preamplifier circuit for use with an iconoscope combines a cascode arrangement with negative feedback. Advantages claimed are reduction of noise, of beam-current requirements and of spurious signals, and improvement in the rendering of the grey scale.

621.397.611.2 : 621.385.832 **875**

A Television Camera with an Image Iconoscope.—C. J. Seur. (*Commun. News*, Sept. 1953, Vol. 14, No. 1, pp. 29–34.) The equipment used in the Bussum studio for experimental transmissions is described.

621.397.621.2.001.4 **876**

Simple Linearity-Measuring Instrument.—Beauchamp. (See 811.)

621.397.7 **877**

Studio Equipment used for Television Broadcasting in the Netherlands.—J. M. Olthuis. (*Commun. News*, Sept. 1953, Vol. 14, No. 1, pp. 19–28.) Description of the equipment of the studios at Bussum, near Amsterdam.

621.397.7 : 534.86 **878**

The Sound Equipment in the Television Studio at Bussum.—A. Cramwinckel. (*Commun. News*, Sept. 1953, Vol. 14, No. 1, pp. 34–39.)

621.397.82 879

A Level Compensator for Telephotograph Systems.—T. A. Jones & W. A. Phelps. (*Elect. Engng, N.Y.*, Sept. 1953, Vol 72, No. 9, pp. 787–791.) The interference modulation in picture transmission via wide-band carrier equipment is effectively cancelled out by introducing an equal and opposite interference signal obtained by detecting a single-frequency pilot current transmitted simultaneously with the picture. Block diagrams and performance characteristics are given.

621.397.621.2 : 621.316.729 880

Flywheel Synchronization of Sawtooth Generators. [Book Review]—P. A. Neeteson. Publishers: Cleaver-Hume Press, London, 156 pp., 21s. (*Wireless Engr*, Jan. 1954, Vol. 31, No. 1, pp. 27–28.) "... a necessary book for the designer."

TRANSMISSION

621.376.223 881

Balanced Crystal-Diode Modulator.—W. F. Byers. (*Radio & Telev. News, Radio-Electronic Engng Section*, Sept. 1953, Vol. 50, No. 3, pp. 10–11, 27.) Description of the low-power Si-diode modulator Type 1000-P7, giving linear operation over the range 0–20 Mc/s at carrier frequencies from 60 Mc/s to 2·5 kMc/s. Circuit diagram and performance figures are given.

621.396.61.029.58 : 621.396.65 882

Single-Sideband Multi-Channel Operation of Short-Wave Point-to-Point Radio Links: Part 4(a)—An Independent-Sideband High-Power Short-Wave Transmitter—The Radio and Power Units.—H. E. Sturgess & F. W. Newson. (*P.O. elect. Engrs' J.*, Oct. 1953, Vol. 46, Part 3, pp. 140–143.) The transmitter can provide peak power up to 70 kW in the frequency range 4–22 Mc/s. By using the two-channel drive unit described in part 2 [2175 of 1953 (Owen & Ewen)] the transmitter can also be used for d.s.b. telephony and c.w. and m.c.w. telegraphy.

621.396.61.029.62 883

A New V.H.F. Transmitter for Frequency Modulation.—W. Grimbaldeston. (*G.E.C. Telecommun.*, Sept. 1953, No. 17, pp. 27–33.) Description of the BRT-108 250-W transmitter, for 71·5–100 Mc/s. Ph.m. corrected to f.m. over the required audio range is used. The nominal frequency deviation is ± 15 kc/s for 0·5 mV across the 15-Ω input, at 1 kc/s modulation frequency.

621.396.662 : 621.316.7 884

Automatic Control System with Provision for Scanning and Memory.—N. H. Young. (*Elect. Engng, N.Y.*, Sept. 1953, Vol. 72, No. 9, pp. 782–784.) The control element (e.g. a tuning capacitor) is scanned through its entire range of adjustment and the input voltage is fed, via a diode, to the 'memory' capacitor, causing it to charge up to the maximum peak value. On re-scanning, the input voltage is compared with this peak value; the control element is stopped when they are equal. A simplified circuit diagram is given, and a radio transmitter embodying the system is briefly described.

621.396.665 885

Circuits for Limiting Peak Voltages.—E. G. Beard. (*Philips tech. Commun., Aust.*, 1953, No. 3, pp. 11–15.) A system of amplified a.g.c. for preventing overmodulation of a transmitter is described. The peak signal voltages trigger a quiescent 1-Mc/s oscillator which then oscillates in a series of pulses. The length of the pulse sequence is a function of the signal amplitude. The rectified and integrated pulses are used for the a.g.c. bias.

621.396.712 : 621.396.61 886

The R.T.F. Transmitting Stations at Sélestat and Allouis L.W.—A. Gaillard. (*Onde élect.*, Aug./Sept. 1953, Vol. 33, Nos. 317/318, pp. 489–496.) The long-wave transmitter at Allouis, which was destroyed in 1944, was re-started in October 1952. The power is 250 kW; it is planned to add a second transmitter to bring the total power up to 450 kW. Anode modulation is used, with two Type-E3056 valves in push-pull in the r.f. stage. The aerial is a folded unipole designed to handle a bandwidth 12·4% of the carrier frequency; its total height is 308 m. The new Sélestat station, intended to serve the whole of Alsace, also came into full operation in October 1952. It has two 150-kW transmitters, each comprising two units. There are two widely spaced aerials, one 115 m and the other 90 m high. The heat developed at the anodes of the power valves is recovered and used for heating the buildings. See also 1735 of 1952.

VALVES AND THERMIONICS

621.314.632 887

Post-Injection Barrier Electromotive Force of *p-n* Junctions.—B. R. Gossick. (*Phys. Rev.*, 15th Aug. 1953, Vol. 91, No. 4, pp. 1012–1013.) By injecting carriers across a *p-n* junction with a high-back-voltage point-contact diode in series, the post-injection barrier e.m.f. may be observed under approximately open-circuit conditions. From measurements using a CK708 diode, the calculated e.m.f. is $\sim 0{\cdot}2$ V at room temperature.

621.314.632 : 546.289 888

Effect of Transit Time on Ge-Rectifier Behavior.—R. Bray & B. R. Gossick. (*Phys. Rev.*, 15th Aug. 1953, Vol. 91, No. 4, pp. 1011–1012.) The forward characteristics of Ge point-contact rectifiers were measured using 0·4-μs pulses. Resistance was very much higher at the beginning of the pulse than at the end, when it reached the d.c. value. Thus transit times $<0{\cdot}4$ μs are involved. In *p-n*-junction rectifiers, the resistance takes longer to change, and is still much higher than the d.c. value at the end of a 3·6-μs pulse.

621.314.632 : 546.289 889

The Manufacturing and Testing of Germanium Rectifiers.—C. Peters & H. Strong. (*G.E.C. Telecommun.*, Sept. 1953, No. 17, pp. 34–39.) An illustrated account dealing with point-contact Ge diodes.

621.314.632 : 621.376.233 890

Crystal-Mixer Design at Frequencies from 20 000 to 60 000 Mc/s.—C. R. Ditchfield. (*Proc. Instn elect. Engrs*, Part III, Nov. 1953, Vol. 100, No. 68, pp. 365–371.) Crystal valves designed during the war are reviewed. A new design of plug-in waveguide type is described and some performance figures are given. With a minor modification to the holder, this type can be used as a harmonic generator.

621.314.7 891

A Germanium *N-P-N* Alloy Junction Transistor.—D. A. Jenny. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1728–1734.) The transistor discussed is the counterpart of the *p-n-p* type described by Law et al. (876 of 1953). It is made by fusing Pb-Sb alloy into both faces of a thin wafer of *p*-type single-crystal Ge. Compared with the *p-n-p* type, the penetration of the alloy is more uniform, giving flatter junctions and better control of junction spacing. Test figures for a typical lot of 100 units are given; the best values obtained are 45 db for the power gain, 0·997 for α and 3 db for the 1-kc/s noise

factor. The h.f. performance is better than that of the *p-n-p* type, but the improvement is not so great as would be expected from the electron/hole mobility ratio.

621.314.7 **892**

Home-Made Transistors.—P. B. Helsdon. (*Wireless World*, Jan. 1954, Vol. 60, No. 1, pp. 20–23.) Practical details are given for converting selected Ge diodes into point-contact transistors.

621.314.7 **893**

The Surface-Barrier Transistor: Part 1 — Principles of the Surface-Barrier Transistor.—W. E. Bradley. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1702–1706.) The 'surface-barrier' transistor comprises a plate of *n*-type single-crystal Ge with the thickness at a central region reduced to a few microns, and emitter and collector electrodes plated respectively on to the two faces at the thinned region. A method of production is used which permits accurate control of the geometry. An explanation is given of the hole-emission, conduction and collection mechanisms involved in the operation; this depends on the formation of a layer about 0·0001 in. thick just below the Ge surface, within which there are practically no free charge carriers. Efficient operation at frequencies > 60 Mc/s has been achieved with a supply voltage of 3 V.

621.314.7 **894**

The Surface-Barrier Transistor: Part 4 — On the High-Frequency Performance of Transistors.—R. Kansas. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1712–1714.) A theoretical determination of the α-cut-off frequency for the surface-barrier transistor is given, based on analysis presented by Steele (881 of 1953) for junction transistors. Values found from the theory are compared with experimental values. The effect of nonuniformity of the thickness of the Ge is demonstrated. Part 3: 692 above.

621.314.7 : 537.311.33 **895**

The Surface-Barrier Transistor: Part 5 — The Properties of Metal-to-Semiconductor Contacts.—R. F. Schwarz & J. F. Walsh. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1715–1720.) An investigation is made of the properties of the plated In-Ge junctions formed by the technique used in the production of the surface-barrier transistor (see 896 below). Measured I/V characteristics are only slightly different from those for alloyed junctions. The shape and capacitance of the barrier are discussed; from a comparison of measured capacitance values with theoretically derived values it is inferred that the effective area of the barrier is of the same order of magnitude as the actual area of the plated electrode. Expressions are derived for the hole and electron currents across the barrier, and it is shown that enhanced hole current is obtained in the transistor as a result of the relatively small distance between the emitter and collector electrodes. Part 4: 894 above.

621.314.7.002.2 **896**

The Surface-Barrier Transistor: Part 2 — Electrochemical Techniques for Fabrication of Surface-Barrier Transistors.—J. W. Tiley & R. A. Williams. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1706–1708.) Details are given of the method used to reduce the thickness of the Ge plate (see 893 above). Two glass nozzles of diameter about 0·005 in. are mounted so as to direct jets of electrolyte on to the two faces of the plate, the latter being connected as anode. An even etch is obtained. The influence of illumination and of the high resistivity of the surface barriers on the passage of the etching current is discussed. When the etching is completed, the polarity of the system is reversed and the transistor electrodes are plated on using the same arrangement of equipment. Experiments indicate that In is a suitable metal for the electrodes. In typical units the diameter of the etched pit is 0·015 in., that of the emitter is 0·003 in., and that of the collector 0·006 in. The unit is provided with a Ni base tab by which it is mounted on a glass stem. Part 1: 893 above.

621.38.002.2 : 53 **897**

Physics in the Electronic Valve Industry.—J. Thomson. (*Brit. J. appl. Phys.*, Sept. 1953, Vol. 4, No. 9, pp. 262–267.) The importance of physics in the development and manufacturing stages of production of various electronic devices is indicated.

621.385 : 621.372.57 **898**

Starvation Circuits and their Limitations.—Erdle. (See 680.)

621.385 : 621.396.662 **899**

Tuning-Indicator Valves.—F. Malsch. (*Elektrotech. Z., Edn A*, 1st Sept. 1953, Vol. 74, No. 17, pp. 497–500.) Description of the construction and operation of various types of indicator valve, including some relatively little used ones.

621.385 : 681.142 **900**

The Univac Tube Program.—Hinkelman & Kraus. (See 647.)

621.385.029.6 **901**

Some Recent Work in France on New Types of Valves for the Highest Radio Frequencies.—R. Warnecke & P. Guénard. (*Proc. Instn elect. Engrs*, Part III, Nov. 1953, Vol. 100, No. 68, pp. 351–362.) The valves reviewed include reflex klystrons, multicavity klystrons, velocity-modulation valves with distributed buncher, travelling-wave valves, magnetrons, magnetron-type travelling-wave valves, and backward-wave valves (called carcinotrons). Theory is given, design aspects are discussed, and some performance figures are presented. References to papers dealing with these valves in greater detail are included.

621.385.029.6 : 621.372.2 **902**

Analysis of a Transmission-Line Type of Thermionic-Amplifier Valve.—I. A. D. Lewis. (*Proc. Instn elect. Engrs*, Part IV, Oct. 1953, Vol. 100, No. 5, pp. 16–24.) Analysis is presented for a line comprising two helices in proximity to an earthed straight conductor. Two waves in each direction, with different phase velocities, can co-exist. The design of a valve is discussed with a cylindrical cathode and coaxial helical grid and anode. Waves in the slower mode, in which anode and grid voltages are out of phase, are amplified according to an exponential law; waves in the faster mode, in which anode and grid voltages are in phase, are attenuated by a similar amount. For perfect matching at the ends of the line, the two helices must be wound in opposite senses and the coefficients of inductive and capacitive coupling must be equal. With a valve of this type a balanced output could be obtained with an unbalanced input.

621.385.029.63/.64 **903**

Electron Flow through Small Tubes with Magnetic Focusing.—J. L. Stewart. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, pp. 1236–1240.) A calculation is made of the beam current flowing through a narrow tube or between a pair of parallel plates, taking account of the helical electron motion due to the magnetic focusing. The results are presented graphically. Expressions are also given for the current intercepted and for an equivalent beam conductance relating the power

associated with the rotational motion of the beam to the intensity of an applied transverse electric field. The theory is applicable to travelling-wave valves.

621.385.029.63 : 621.376.3 : 621.397.26 **904**

A 50-Watt F.M. Magnetron for Relay Service.—D. P. Kennedy. (*Tele-Tech*, Aug. 1953, Vol. 12, No. 8, pp. 66–68.) Outline descriptions are given of the QK-174C magnetron oscillator, which is continuously tunable over the frequency range 1·99–2.11 kMc/s, and of a television relay transmitter incorporating it. The associated wide-band f.m. receiver is also briefly described.

621.385.029.64 **905**

Low-Noise Traveling-Wave Tubes for X-Band.—D. A. Watkins. (*Proc. Inst. Radio Engrs*, Dec. 1953, Vol. 41, No. 12, pp. 1741–1746.) Tests on valves using velocity jumps for noise reduction (1470 of 1952) show that best results are obtained with a single-jump arrangement in which the electrodes are shaped so as to make the transition from the low-voltage to the high-voltage space relatively gradual. A valve with a noise figure of 11·3 db and a gain of 18 db at 9 kMc/s is described. The variation of noise figure with magnetic field, operating voltage and cathode temperature is shown graphically.

621.385.032.216 **906**

The Life of Oxide Cathodes in Modern Receiving Valves.—G. H. Metson, S. Wagener, M. F. Holmes & M. R. Child. (*Proc. Instn elect. Engrs*, Part III, Nov. 1953, Vol. 100, No. 68, pp. 371–372.) Discussion on 1781 of 1952.

621.385.032.216 : 621.317.332 **907**

The Dependence of Mutual Conductance on Frequency of Aged Oxide-Cathode Valves and its Influence on their Transient Response.—J. R. Tillman, J. Butterworth & R. E. Warren. (*Proc. Instn elect. Engrs*, Part IV, Oct. 1953, Vol. 100, No. 5, pp. 8–15.) Full paper. See 2838 of 1953.

621.385.1 **908**

Valve Codes.—M. H. N. Potok. (*Wireless World*, Jan. 1954, Vol. 60, No. 1, pp. 38–40.) An examination of the possibility of devising a method of designation which will serve not only to distinguish valves which are not interchangeable but also to give information about the properties of the valve designated.

621.385.2 **909**

The Space-Charge Smoothing Factor: Part 3.—C. S. Bull. (*Proc. Instn elect. Engrs*, Part IV, Oct. 1953, Vol. 100, No. 5, pp. 47–50.) In a previous paper (2383 of 1950), thirty partial differential coefficients were enumerated which together express the characteristics of a diode. A study of the effect of fluctuations on one of these coefficients brings to light a serious error in all prior work on the subject. As a result, it may be assumed that the total emission fluctuates according to the law derived by Schottky in 1918, and estimates of the fluctuations can hence be obtained in closer agreement with values observed experimentally. Part 2: 291 of 1953.

621.385.3.029.63 **910**

A Disc-Seal Triode as a U.H.F. Amplifier.—S. C. Peek. (*Sylvania Technologist*, Oct. 1953, Vol. 6, No. 4, pp. 81–85.) The construction of the Type-6BA4 planar triode is described, and the results of performance tests in a 450–900-Mc/s grounded-grid coaxial amplifier are given. At 890 Mc/s a power gain of 14 db and a noise figure of 10 db were obtained.

621.385.83 **911**

Spatially Alternating Magnetic Fields for Focusing Low-Voltage Electron Beams.—J. R. Pierce. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, p. 1247.) A note referring to the work of Courant et al. (1454 of 1953). The solution of the equations of motion of an electron in axially symmetrical, converging, periodic magnetic fields shows that dense beams can be stable in such fields. Periodic focusing is discussed briefly.

621.385.83 : [621.317.329 + 517.944 **912**

Electrostatic Potential Plotting for Use in Electron-Optical Systems.—Kuo-Chu Ho & R. J. Moon. (*J. appl. Phys.*, Sept. 1953, Vol. 24, No. 9, pp. 1186–1193.) A noniterative numerical method is developed for solving a partial differential equation, the boundary conditions of which are not known over the entire closed boundary. This method is used to calculate the shapes of beam-forming electrodes for a rectilinear flow. Complete agreement is obtained with Pierce's experimental results (4275 of 1940) and with the results of electrolyte-trough determinations.

621.385.832 : 621.317.32 **913**

Measurement of Voltage using a Simple Electron-Beam Valve.—Lieb. (See 798.)

621.385.832 : 621.318.572 **914**

The E1T Decade Counter Tube.—(*Electronic Applic. Bull.*, May 1953, Vol. 14, No. 5, pp. 71, 76.) Corrections and addendum to paper noted in 603 of February.

621.385.832.002.2 **915**

The Production of Emiscope Cathode-Ray Tube Gun-Assemblies.—(*Machinery, Lond.*, 18th Sept. & 23rd Oct. 1953, Vol. 83, Nos. 2131 & 2136, pp. 555–563 & 795–800.)

621.385.832.002.2 : 681.142 **916**

Cementing Metal Screens to Cathode Ray Tubes.—R. W. Holmes. (*Mater. & Meth.*, Sept. 1953, Vol. 38, No. 3, pp. 184, 186.) The method described was used for fixing fine mesh screens externally to the screens of c.r.-tube storage units for the AVIDAC digital computer.

621.385.832.012 **917**

Experimental Determination of the Characteristic-Curve Index in Cathode Ray Tubes.—E. Gundert. (*Z. angew. Phys.*, Sept. 1953, Vol. 5, No. 9, pp. 340–341.) The cathode current I_k in a triode gun is related to the control grid voltage U_g by the equation $I_k = K(U_g - U_{sp})^n$ where U_{sp} is the value of U_g for $I_k = 0$. Logarithmic plotting presupposes a knowledge of U_{sp}, which, owing to the Maxwell electron velocity distribution, is not easily determined. A formula is derived from which n can be calculated by substituting the values of U_g corresponding to three values of I_k in geometrical progression. For cathode currents up to about 100 μA, $n \approx 2{\cdot}5$.

621.387.032.212 : 621.396.665 **918**

Gas-Discharge Tubes for Control of Microwave Attenuation.—D. H. Pringle & E. J. Whitmore. (*J. sci. Instrum.*, Sept. 1953, Vol. 30, No. 9, pp. 320–323.) Details are given of the construction and operation of cold-cathode tubes as attenuators for the 3-cm waveband. Operation depends on the interaction between the microwave field and the electron gas supported by the discharge plasma. Construction is based on that of conventional t.r. switches; a high-Q narrow-band type and a low-Q wide-band type are described. Applications to a.g.c. and modulator circuits are discussed.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534 : 061.3 — 919

International Congress on Acoustics, Delft (Netherlands), 15th–25th June 1953.—P. Chavasse & R. Lehmann. (*Ann. Télécommun.*, Oct. 1953, Vol. 8, No. 10, pp. 335–338.) A brief report of the proceedings, with titles of the papers presented. See also 2855 of 1953.

534.1.001.362 — 920

Transformer Couplings for Equivalent-Network Synthesis.—B. B. Bauer. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 837–840.) Equivalent circuits for mechanical arrays, based on the impedance analogy, are obtained in a simple way by introducing ideal transformer couplings.

534.121.2 — 921

On the Vibration of Mass-Loaded Membranes.—E. T. Kornhauser & D. Mintzer. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 903–906.) The conventional treatment originated by Rayleigh is discussed, and some of the results are shown to be invalidated by an unfounded assumption.

534.13 : 534.414 — 922

Theory of the Free Vibrations of Isotropic Elastic Media.—E. Ledinegg & P. Urban. (*Acta phys. austriaca*, Sept. 1953, Vol. 7, No. 4, pp. 420–435.) First-order perturbation theory is used to calculate the natural frequencies of an inhomogeneous system of arbitrary form. The method is used to determine the variation of the natural frequency of a system when its elastic constants are subjected to small spatially distributed variations. Calculations are made of the variation of resonance frequency of a cylindrical acoustic resonator on introduction of (*a*) an axial rod, and (*b*) a transverse plate. Application to the determination of Lamé's constants is discussed.

534.13 : 621.395.61/.62 — 923

The Coupling of Mechanical and Acoustic Vibration Systems.—W. Güttner. (*Acustica*, 1953, Vol. 3, No. 4, pp. 201–206. In German.) A wide-band transducer is obtained by coupling a Helmholtz resonator to the mechanical system. The optimum bandwidth conditions are attained when the reception, or the radiation, does not involve the resonator. As an example, the frequency response of a crystal microphone is determined.

534.141.4 — 924

On Edge Tones and Associated Phenomena.—A. Powell. (*Acustica*, 1953, Vol. 3, No. 4, pp. 233–243.) Edge-tone phenomena occurring at high jet speeds have been photographed and analysed.

534.2 — 925

The Concept of Radiation Scattering and its Application to Reinforced Cylindrical Shells.—M. C. Junger. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 899–903.) A method of analysis is developed permitting investigation of complex structures which cannot be treated by the methods previously described (3299 of 1952). The radiation pressure is expressed as the sum of two terms, one corresponding to the contribution from a rigid scatterer and the other to the contribution due to the vibration of the actual scatterer in response to the incident wave. Special cases are examined.

534.2 — 926

Acoustic Streaming at Low Reynolds Numbers.—J. M. Andres & U. Ingard. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 932–938.)

534.2 — 927

Acoustic Streaming at High Reynolds Numbers.—J. M. Andres & U. Ingard. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 928–932.)

534.2 — 928

Acoustic Streaming Equations: Laws of Rotational Motion for Fluid Elements.—W. L. Nyborg. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 938–944.)

534.2 — 929

The Propagation of Sound in a Medium with Random Fluctuations of the Refractive Index.—V. Ya. Kharanen. (*C. R. Acad. Sci. U.R.S.S.*, 11th Jan. 1953, Vol. 88, No. 2, pp. 253–256. In Russian.) The effect of small

fluctuations in a medium whose refractive index is nearly unity is considered theoretically. An expression for the deflection of the sound wave is derived. The results of the particular cases considered can be applied to the problem of the propagation of sound in the surface layer of the sea. See also 847 of 1947 (Bergmann).

534.2-13 **930**

The Attenuation of Sound Propagated over the Ground.—J. D. Hayhurst. (*Acustica*, 1953, Vol. 3, No. 4, pp. 227–232.) The effect of wind on sound propagation over a concrete runway was investigated experimentally for distances up to 800 m. The only significant parameter is the component of wind along the direction of propagation, but the attenuations are statistically independent of the absolute wind speed. The change of attenuation with frequency and with height above ground is shown graphically.

534.2-14 **931**

Wave Propagation in a Randomly Inhomogeneous Medium: Part 1.—D. Mintzer. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 922–927.) "The propagation of sound pulses from a point source in a medium where the index of refraction varies randomly is studied by means of a Born approximation to the wave equation. The coefficient of variation (standard deviation of the amplitude of a series of pulses, expressed as a percentage of the mean amplitude of the series) is evaluated for pulse lengths short compared with the time in which the refractive index varies significantly, and for ranges large compared with the wavelength of the sound. The results are in agreement with the experiments of Sheehy [1055 of 1950]."

534.21-16 **932**

Magnetic Damping of Acoustic Waves in Conducting Media.—E. T. Kornhauser. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 1011–1012.) An elementary analysis is presented and the results are compared with those of Anderson (2635 of 1953).

534.213-14 **933**

The Acoustic Properties of Gas-Bubble Screens in Water.—E. Meyer & E. Skudrzyk. (*Akust. Beihefte*, 1953, No. 3, pp. 434–440.)

534.213.4-14 : 534.64 **934**

Acoustic Impedance of Rectangular Tubes.—J. K. Wood & G. B. Thurston. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 858–860.) Theoretically derived values of the impedance of a section of a system of infinite parallel planes are in good agreement with measured values for long narrow tubes, when the latter are corrected for end effects.

534.213.4-14 : 534.64 **935**

End Corrections for a Concentric Circular Orifice in a Circular Tube.—G. B. Thurston & J. K. Wood. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 861–863.) The values of the end correction found experimentally for the acoustic impedance of a tube with an orifice are in good agreement with values derived theoretically, treating the orifice as a plane piston source.

534.23 **936**

Optimum Directivity Patterns for Linear Point Arrays.—R. L. Pritchard. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 879–891.) Extended version of 3292 of 1948 (Pritchard & Rosenberg).

534.23 **937**

Approximate Calculation of the Directivity Factor of Linear Point Arrays.—R. L. Pritchard. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 1010–1011.)

534.232 : 546.431.824-31 **938**

Barium Titanate Admittance-Temperature Characteristics.—A. L. Lane. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 873–878.) Admittance variations over the temperature range 34°–67°F are studied for underwater transducers made of $BaTiO_3$ with and without addition of lead as a temperature stabilizer. Though the dielectric and piezoelectric constants of the material vary widely over this temperature range, it is possible for the transducer admittance to vary very little at certain frequencies near resonance.

534.232-14 : 621.395.61 **939**

Notes on Measurements of the Efficiency of Transducers for Water-Borne Sounds.—H. Thiede. (*Akust. Beihefte*, 1953, No. 3, pp. 449–451.) A method particularly applicable in the sonic and lower ultrasonic frequency ranges is described. Measurements of power absorbed for constant excitation at frequencies well below, well above and at the mechanical resonance frequency are made, the last-mentioned measurement being repeated with the transducer radiating in air. Efficiency can then be calculated.

534.321.9 **940**

Intensities produced by Jet-Type Ultrasonic Vibrators.—H. O. Monson & R. C. Binder. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 1007–1009.) An investigation of the influence of inlet pressure, cup position and physical proportions on the intensity and frequency of the vibrations.

534.414 : 534.845 **941**

The Impedance of a Resistance-Loaded Helmholtz Resonator.—U. Ingard & R. H. Lyon. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 854–857.) Resonators with a damping screen are considered, and the dependence of the impedance on the distance between screen and aperture is investigated theoretically; the resistance and reactance components are differently affected. The results are discussed in relation to the design of perforated facings.

534.62 + 621.317.3.029.63/.64 **942**

A New Anechoic Chamber for Sound Waves and Short Electromagnetic Waves.—E. Meyer, G. Kurtze, H. Severin & K. Tamm. (*Akust. Beihefte*, 1953, No. 3, pp. 409–420.) Description of the design and construction of a chamber of dimensions 5·5 m × 10 m × 14 m, with a reflection factor < 10% for sound waves of frequency > 70 c/s and for e.m. waves of frequency > 1 kMc/s. The treatment of the walls is basically similar to that in the pre-war anechoic chamber at the Technische Hochschule, Charlottenburg [6 of 1948 (Meyer et al.)], but behind the fibreglass wedges a cavity 12 cm deep has been provided which, together with slots between the wedges, forms a resonator system. Graphite powder drawn into the wedges by suction provides the attenuation of the e.m. waves.

534.62 **943**

On the Measurement of Power Radiated from an Acoustic Source.—W. G. Cady & C. E. Gittings. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 892–896.) An account is given of experiments which verified the theory developed by Borgnis (2536 of 1953). A slab of ρc rubber, a 90° wedge and a cavity radiometer were used as absorbers.

534.78 **944**

General Analysis of the Acoustic Structure of Speech Sounds by the Superposition of Periodic and Random Components.—R. Husson & R. Saumont. (*C. R. Acad.*

Sci., Paris, 9th Dec. 1953, Vol. 237, No. 23, pp. 1555–1556.) A discussion of the physiological origin of the different types of component and of the ability of the ear to discriminate between them. A new classification of phonemes is given.

534.78 **945**

A Study of the Building Blocks in Speech.—C. M. Harris. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 962–969.) A technique is used in which speech elements are recorded on magnetic tape and joined together as required.

534.78 **946**

A Speech Synthesizer.—C. M. Harris. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 970–975.) The device uses a keyboard arrangement to select for reproduction speech elements magnetically recorded on a drum.

534.78 **947**

Some Experiments on the Recognition of Speech with One and with Two Ears.—E. C. Cherry. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 975–979.)

534.832 **948**

Vibration of Plates Covered with a Damping Layer.—A. van Itterbeek & H. Myncke. (*Acustica*, 1953, Vol. 3, No. 4, pp. 207–212.) The time taken for a halving of the initial amplitude was determined experimentally for steel plates 3–26 mm thick. The variation with the mass of paint used and with temperature is shown graphically.

534.832 : 534.121.1 **949**

Sound Radiation from Plates Excited in Flexural Vibration.—K. Gösele. (*Acustica*, 1953, Vol. 3, No. 4, pp. 243–248. In German.) The sound energy radiated per unit area of the plate is a function of the ratio f/f_{gr} where f is the frequency of the sound and f_{gr} the critical frequency of the plate. For values of this ratio > 1 the radiation is independent of the total area of the plate, for unity value the radiation increases with the area and for values < 1 it decreases to a limiting value. The application of the theoretical results to the construction of single- and double-shell walls is mentioned.

534.84 **950**

Room Acoustics.—H. J. Sabine. (*Trans. Inst. Radio Engrs*, July/Aug. 1953, Vol. AU-1, No. 4, pp. 4–12.) A brief survey of the transmission of sound through the air in a room, and of the ways in which a sound signal may be modified by the acoustic characteristics of the room.

534.84 **951**

Measurements of the Acoustical Properties of Two Roman Basilicas.—A. C. Raes & G. G. Sacerdote. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 954–961.)

534.845-14 **952**

Pulse Method of Measurement of the Reflection from Absorbers of Water-Borne Sound in Tubes.—W. Kuhl, H. Oberst & E. Skudrzyk. (*Akust. Beihefte*, 1953, No. 3, pp. 421–433.) Measurements are made on a c.r.o. of the amplitude of pulses reflected from resonance-type absorbers at the end of a water-filled tube. Pulse durations between 0·5 and 1·5 ms are used, with frequencies in the range 9–22 kc/s. Sources of error, and their elimination, are considered in detail.

621.395.61 **953**

Derivation of the Laws of Force for All Magnetic and All Electric Transducers from a Single Law in Each Case.—F. A. Fischer. (*Akust. Beihefte*, 1953, No. 3, pp. 441–448.) If the magnetic energy of a system of two coupled coils and the electric energy of two coupled electric conductors respectively are calculated, the mechanical force is given by the derivative of the energy with respect to x, assuming that the x coordinate is the only one along which the system varies. The different types of transducers result from a proper choice of this variable coordinate.

621.395.61 **954**

The Theoretical Sensitivity of Three Types of Rectangular Bimorph Transducers.—E. G. Thurston. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 870–872.) Application of the method discussed previously (926 of 1953) to the cases of (*a*) the corner-loaded square bimorph, (*b*) the rectangular bimorph supported along two sides and uniformly loaded, and (*c*) the rectangular bimorph loaded only along a strip.

621.395.61 **955**

A Miniature Piezoelectric Microphone.—J. Medill. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 864–866.) A Rochelle-salt microphone developed for use as a secondary standard in acoustic testing has a diameter of $1\frac{1}{4}$ in. Details are given of its construction and performance.

621.395.61 **956**

A Miniature Microphone for Transistorized Amplifiers.—B. B. Bauer. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 867–869.) The construction and performance of a moving-iron microphone suitable for use in hearing aids are described.

621.395.612.451 **957**

The Uniaxial Microphone.—H. F. Olson, J. Preston & J. C. Bleazey. (*Trans. Inst. Radio Engrs*, July/Aug. 1953, Vol. AU-1, No. 4, pp. 12–19.) Reprint. See 2199 of 1953.

621.395.623.7 : 534.321.9 **958**

Interaction of Two Ultrasonic Waves in Air.—J. Maulois. (*Toute la Radio*, Nov. 1953, Vol. 20, No. 180, pp. 352–354.) Report of experiments made by S. Klein using two ionophone loudspeakers to produce either (*a*) unmodulated waves of slightly different frequencies, or (*b*) an unmodulated and a modulated wave of the same carrier frequency. Audible beats were produced. The possibility of designing a loudspeaker requiring neither horn nor baffle is discussed.

621.395.623.7.011.21 **959**

Loudspeaker Impedance.—V. Salmon. (*Trans. Inst. Radio Engrs*, July/Aug. 1953, Vol. AU-1, No. 4, pp. 1–3.) The operation and testing of loudspeakers, and the calculation of available input power, require knowledge of five impedances, which are here discussed and defined. In estimating loudspeaker performance with different output stages or at extreme frequencies, the source regulation is an important factor. Its measurement is described.

AERIALS AND TRANSMISSION LINES

621.315.212 **960**

Modern Coaxial-Cable Technique in Great Britain.—E. Baguley. (*Elect. Commun.*, Sept. 1953, Vol. 30, No. 3, pp. 186–216.) A discussion of the design, manufacture and testing of long-distance telephone and television wide-band coaxial cables. Comparative performance figures and curves for cables made between 1935 and 1950 are given. The tests described include a 5-kV flashover test, pulse-echo test for detecting irregularities of impedance, h.f. attenuation measurement, impedance measurement between 50 kc/s and 10 Mc/s and cross-talk measurements.

621.315.212 : 621.372.2 **961**

The Transmission Characteristics of Coaxial Cables.—E. Adam. (*Öst. Z. Telegr. Teleph. Funk Fernsehtech.*, July/Aug. & Sept./Oct. 1953, Vol. 7, Nos. 7/8 & 9/10, pp. 98–107 & 122–134.) A simple treatment of the subject based on work published by various authors, from Maxwell up to the present time.

621.372.2 + 538.566 **962**

The Effect of the Radiation Condition in the case of Complex Wave Number, and its Significance in the Problem of Surface Waves.—Haug. (See 1162.)

621.372.2 **963**

Normalized Impedance and Reflection Coefficient.—P. A. Lindsay. (*Wireless Engr*, Feb. 1954, Vol. 31, No. 2, pp. 43–47.) Starting from the formula giving the impedance Z at the end of a transmission line of length l in terms of the characteristic impedance Z_0, the propagation constant and l, perspective drawings are constructed of surfaces representing the relations between the normalized load impedance Z/Z_0 and the voltage coefficient of reflection.

621.372.2 : 537.226 **964**

Propagation in a Dielectric Transmission Line.—M. Jouguet. (*C. R. Acad. Sci., Paris*, 21st Dec. 1953, Vol. 237, No. 25, pp. 1656–1657.) In addition to the E_0 and H_0 modes, mixed modes with m-order symmetry round the circumference of the line can exist. Two infinite series of modes designated $(EH)'_{m,n}$ and $(EH)''_{m,n}$ correspond to any value of m. The values of the cut-off frequency, phase velocity and attenuation are determined for various cases.

621.372.2 + 538.566] : 621.3.012 **965**

New Chart for the Solution of Transmission-Line and Polarization Problems.—G. A. Deschamps. (*Elect. Commun.*, Sept. 1953, Vol. 30, No. 3, pp. 247–254; *Trans. Inst. Radio Engrs*, March 1953, Vol. MTT-1, No. 1, pp. 5–13.) This chart, an orthographic projection of the Poincaré sphere (see 2418 of 1951), is considered as a modification of the Smith chart. It is normally used with a hyperbolic protractor. The examples given of its applications include the evaluation of the reflection coefficient of a stratified medium and of junction-insertion loss. Polarization problems are treated by assimilating polarization ratio to reflection coefficient.

621.372.43 **966**

Transmission-Line Matching System.—R. E. Collin & J. Brown. (*Wireless Engr*, Feb. 1954, Vol. 31, No. 2, pp. 31–35.) The two-section quarter-wave transformer is analysed. By tolerating a certain mismatch at the centre of the band it is possible to obtain a perfect match at two frequencies located symmetrically about the centre frequency. This arrangement gives an increase of 20–45% in bandwidth over the commonly used binomial transformer, which gives perfect matching at the centre frequency only. Simple design procedure and performance curves are presented.

621.372.8 **967**

Velocity of Energy in Waveguides.—G. Sincich. (*Alta Frequenza*, Oct. 1953, Vol. 22, No. 5, pp. 239–243.) A calculation is made of the instantaneous energy velocity for the TM or TE mode. The velocity is always less than that for a free wave; its value is zero, maximum or equal to the group velocity according as the longitudinal component of the electric field (for the TM mode) or the magnetic field (for the TE mode) is maximum, zero or equal to its r.m.s. value respectively.

621.372.8 **968**

On the Propagation Constant in Gentle Circular Bends in Rectangular Wave Guides — Matrix Theory.—A. T. de Hoop. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1325–1327.)

621.396.67 **969**

A Note on the Cylindrical Antenna of Noncircular Cross Section.—Y. T. Lo. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1338–1339.) The equivalent radii are derived for aerials of polygonal and elliptical cross-section.

621.396.67.012.12 **970**

An Automatic Recorder of Aerial Radiation Diagrams.—E. G. Hamer & J. B. L. Foot. (*J. Brit. Instn Radio Engrs*, Jan. 1954, Vol. 14, No. 1, pp. 33–42.) The instrument described compares a local a.f. reference signal with an a.f. signal of the same frequency and of amplitude proportional to the r.f. signal from the aerial. Arrangements are provided for mounting large aerials at various heights, and for the presentation of results in different ways.

621.396.67.029.64 : 621.317.3 **971**

Measurements on Aerials for Centimetre Waves.—Bouix. (See 1127.)

621.396.674.3 : 538.566 **972**

The Interaction between Electromagnetic Wave and Dipole.—F. Borgnis. (*Arch. elekt. Übertragung*, Oct. 1953, Vol. 7, No. 10, pp. 463–466.) The expression for the mean active power abstracted from the e.m. wave by an electric or magnetic dipole is derived in terms of the electric or magnetic field, the length of the dipole (d), and the conjugate of the complex dipole current, from considerations of the near field. The expressions are valid for $d \ll \lambda$ and $r \ll \lambda$, where r is the distance from the dipole. The maximum effective cross-sectional area of either type of dipole with respect to a plane wave is shown to be $(3/8\pi)\lambda^2$.

621.396.677.71 **973**

Vertically Polarized Microwave Antenna.—R. K. Thomas & M. E. Ringenbach. (*Radio & Telev. News, Radio-Electronic Engng Section*, Oct. 1953, Vol. 50, No. 4, pp. 13 . . 27.) A design giving a fan-shaped beam uses a stub-supported rigid coaxial line with longitudinally spaced circumferential slots.

621.396.677.71 **974**

Automatically Deiced X-Band Beacon Antenna.—C. E. Thomas, Jr. (*Electronics*, Jan. 1954, Vol. 27, No. 1, pp. 152–155.) Details are given of a slotted-waveguide array with an omnidirectional radiation pattern and a narrow vertical beam width, built to withstand wind velocities > 150 knots. The radome heating circuit is controlled by a bridge which includes a capacitor exposed to the weather.

621.396.677.859 : 621.396.96 **975**

Designing Radomes for Supersonic Speeds.—S. S. Oleesky. (*Electronics*, Jan. 1954, Vol. 27, No. 1, pp. 130–135.) Designs which will not attenuate or distort the radar beam are discussed.

AUTOMATIC COMPUTERS

681.142 **976**

Phantastron computes Pulse-Width Ratios.—L. D. Findley. (*Electronics*, Jan. 1954, Vol. 27, No. 1, pp. 164–167.) Description of an analogue computer developed for determining the ratio of the widths of two pulses

occurring simultaneously in two channels of a radar system. The output is readily convertible into digital form. Other applications are indicated.

681.142 **977**

Programme Control of an Electronic Computer.—H. Harmuth. (*Acta phys. austriaca*, Sept. 1953, Vol. 7, No. 4, pp. 390–401.)

681.142 **978**

Digital Computers at Manchester University.—T. Kilburn, G. C. Toothill, D. B. G. Edwards & B. W. Pollard. (*Proc. Instn elect. Engrs*, Part II, Oct. 1953, Vol. 100, No. 77, pp. 487–500.) An account is given of the development of the universal high-speed computer; its features include a c.r.-tube store for 10 240 binary digits, an intermediate store for more than 280 000 digits, completely automatic transfer between the two stores, a fast multiplier, and input and output systems using 5-hole teleprinter tape.

681.142 **979**

The Construction and Operation of the Manchester University Computer.—B. W. Pollard & K. Lonsdale. (*Proc. Instn elect. Engrs*, Part II, Oct. 1953, Vol. 100, No. 77, pp. 501–512. Discussion, pp. 540–543.) The account particularly stresses techniques used to achieve reliability and ease of maintenance, and includes details of the performance over a period of about 61 weeks. See also 978 above.

681.142 **980**

Universal High-Speed Digital Computers: a Decimal Storage System.—T. Kilburn & G. Ord. (*Proc. Instn elect. Engrs*, Part II, Oct. 1953, Vol. 100, No. 77, pp. 513–522. Discussion, pp. 540–543.) Three decimal-digit storage systems using c.r. tubes are described. The best compromise as regards speed of operation, storage capacity and reliability is obtained with a c.r.-tube screen comprising ten separate elements. In a serially controlled store holding 32 words of 8 decimal digits the digit period was 40 μs and could be reduced to 30 μs. These results compare favourably with those for the binary store used in the Manchester University computer.

681.142 : 621-526 **981**

The Design and Testing of an Electronic Simulator for a Hydraulic Remote-Position-Control Servo Mechanism.—F. J. U. Ritson & P. H. Hammond. (*Proc. Instn elect. Engrs*, Part II, Oct. 1953, Vol. 100, No. 77, pp. 568–569.) Discussion on 1054 of 1953.

681.142 : 621-526 **982**

Analogue Computers for Feedback Control Systems.—R. A. Bruns. (*Trans. Amer. Inst. elect. Engrs*, 1952, Vol. 71, Part II, pp. 250–254.)

681.142 : 621.314.222 **983**

Transformer-Analogue Network Analysers.—M. W. H. Davies & G. R. Slemon. (*Proc. Instn elect. Engrs*, Part II, Oct. 1953, Vol. 100, No. 77, pp. 469–480. Discussion, pp. 481–486.) The use of voltage transformers as multipliers for complex quantities is explained. A network analyser is described comprising a measuring section and a number of identical panels each with two multiplying units. These panels can be used to represent impedances, admittances, etc. Negative resistance and unilateral mutual inductance can easily be represented. Applications discussed include the solution of linear simultaneous equations.

681.142 : 621.385 **984**

Valve Reliability in Digital Calculating Machines.—L. Knight. (*Electronic Engng*, Jan. 1954, Vol. 26, No. 311 pp. 9–13.) A discussion of measures which can be taken to reduce the number of valve failures and to reduce the inconvenience caused when failures do occur.

681.142 : 621.385.832 **985**

Recent Advances in Cathode-Ray-Tube Storage.—F. C. Williams, T. Kilburn, C. N. W. Litting, D. B. G. Edwards & G. R. Hoffman. (*Proc. Instn elect. Engrs*, Part II, Oct. 1953, Vol. 100, No. 77, pp. 523–539. Discussion, pp. 540–543.) Modifications have been made to the system described by Williams & Kilburn (2258 of 1949) and used in the Manchester University computer; the defocus-focus system and the signal amplifier are discussed particularly. An account is given of experimental work undertaken to clarify the storage mechanism. The theoretical basis of the system is examined; the original theory, though inaccurate in detail, is satisfactory for practical purposes and can be used to predict storage results. The tube operation is analogous to that of a triode valve, the collector, bombarded spot and surrounding screen surface corresponding respectively to the anode, cathode and control grid.

CIRCUITS AND CIRCUIT ELEMENTS

621.318.572 : 621.385.832 **986**

A Multi-Decade Predetermined Counter.—A. Dorn. (*Electronic Applic. Bull.*, June/July 1953, Vol. 14, Nos. 6/7, pp. 91–101.) The automatic four-decade counter described is a modified version of that noted in 603 of February. The maximum counting rate is 12 500 per sec, and the minimum duration of a complete cycle of counts is $\frac{1}{3}$ ms.

621.372 **987**

Directional Coupling with Transmission Lines.—W. L. Firestone. (*Tele-Tech*, Nov. 1953, Vol. 12, No. 11, pp. 95–97 . . 178.) Adaptation of devices developed in connection with waveguides to forms with open-wire lines, for use at lower radio frequencies.

621.372 **988**

Response of an Amplifier Stage with Antiresonant Circuit to an Input Voltage whose Instantaneous Frequency varies linearly as a Function of Time.—P. Poincelot. (*C. R. Acad. Sci., Paris*, 23rd Nov. 1953, Vol. 237, No. 21, pp. 1314–1315.) Analysis is given for an input which can be represented by a particular Fourier integral.

621.372.2 : 534.321.9 **989**

Equivalent-Network Representations for Solid and Mercury Delay Lines.—S. Dairiki, T. E. Lawrence & R. A. Mapleton. (*J. acoust. Soc. Amer.*, Sept. 1953, Vol. 25, No. 5, pp. 841–853.) An equivalent-network representation is obtained from consideration of the piezoelectric properties of the quartz crystal used to convert the electrical energy into ultrasonic energy. A formula is derived for the transfer function of the line. When mercury and fused-quartz lines are compared on the basis of the gain-bandwidth product only, the fused-quartz line is superior; but other factors (e.g. production of spurious signals) must be taken into account when selecting a line for a specific application.

621.372.413 **990**

Characteristics of an Elliptical Electromagnetic Resonant Cavity operating in the TE_{111} Mode.—T. P. Higgins & A. W. Straiton. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1297–1299.) "Equations and graphs are presented of the resonant wavelength and quality factor of elliptical resonant cavities operating in the TE_{111} mode. Both components of this mode are treated and distinctive characteristics of each are shown as a function of eccentricity of the cavity."

621.372.413 **991**

Interaction between Classical Electron and Quantized Electromagnetic Field.—I. R. Senitzky. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1309–1311.) The equations of motion are solved by a method involving the corresponding difference equations, and an expression is derived for the probability of transition between a high-energy state and neighbouring states of the field inside a resonant cavity.

621.372.5 **992**

The Transformation Properties of Loss-Free Quadripoles between Homogeneous Lines, and a Proof of Weissfloch's Transformation Law using Circle Geometry.—H. Lueg. (*Arch. elekt. Übertragung*, Oct. 1953, Vol. 7, No. 10, pp. 478–484.) A method for evaluating certain parameters in the application of Weissfloch's transformation law (3287 of 1943 and back references). This law has applications in measuring technique and circuit theory in the cm-λ and dm-λ regions.

621.372.5 **993**

On the Synthesis of Reactance 4-Poles.—H. J. Carlin & R. La Rosa. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1336–1337.) Using theory developed by Belevitch (1547 of 1952), formulae are derived for the elements of the impedance or admittance matrix of a loss-free quadripole which, when terminated by a resistor, realizes a prescribed physical driving-point impedance.

621.372.5.012 **994**

A Block-Diagram Approach to Network Analysis.—T. M. Stout. (*Trans. Amer. Inst. elect. Engrs*, 1952, Vol. 71, Part II, pp. 255–260.) An extension of the method described by Graybeal (1534 of 1952) to electrical networks, with examples of application in the analysis of ladder, bridged-T and parallel-T networks.

621.372.5.029.64 : 621.318.1 **995**

Ferrites in Microwave Applications.—J. H. Rowen. (*Bell Syst. tech. J.*, Nov. 1953, Vol. 32, No. 6, pp. 1333–1369.) A discussion of the microwave Faraday effect and of the mechanism of power absorption in ferrites. Plane-wave theory is given, and is extended to cover waveguides. The measurement and applications of the effects are surveyed. See also 1233 of 1952 (Hogan).

621.372.512.029.63 : 621.372.21 **996**

Coupled Lines as High-Frequency Transformer.—O. Bronder. (*Fernmeldetech. Z.*, Oct. 1953, Vol. 6, No. 10, pp. 475–480.) Systems comprising two parallel two-conductor lines are considered. Voltage and current distribution and input impedance are calculated in terms of terminating impedance, overlap length and coupling. An indication is given of the requirements to be satisfied for wide-band operation, and some particular arrangements are discussed.

621.372.54 **997**

Tentative Graphical Representation of the Image Transfer Coefficient of Ladder-Type Filters with or without Losses.—J. E. Colin. (*Câbles & Transm.*, July 1953, Vol. 7, No. 3, pp. 242–262.) The method is based on the expression of the image transfer coefficient $p = a + jb$ as a function of frequency in accordance with the classification of filters given previously (2748 of 1949 and 575 of 1950).

621.372.543.2.029.5 **998**

A Set of 0.4-Octave Band-Pass Filters for Frequencies between 10 and 200 kc/s.—H. Pursey. (*Electronic Engng*, Jan. 1954, Vol. 26, No. 311, pp. 31–33.) Filters designed for eliminating harmonics are described. In order to achieve the desired sharp cut-off on the high-frequency side the filters are operated into an abnormally low impedance, about a tenth of the centre-frequency impedance.

621.372.56 : 621.372.8 **999**

Broadband Rotary Waveguide Attenuator.—B. P. Hand. (*Electronics*, Jan. 1954, Vol. 27, No. 1, pp. 184–185.) The attenuator comprises three collinear sections of round waveguide, each with a resistive film arranged in a diametral plane; the middle section is rotated to obtain the desired attenuation. Some performance figures are given for an experimental model; the characteristics are independent of frequency.

621.372.6 **1000**

A General Network Theorem, with Applications.—B. D. H. Tellegen. (*Proc. Instn Radio Engrs, Aust.*, Nov. 1953, Vol. 14, No. 11, pp. 265–270.) Slightly modified reprint of paper noted in 62 of 1953.

621.373.42 **1001**

'Chameleon' Oscillator.—T. Roddam. (*Wireless World*, Feb. 1954, Vol. 60, No. 2, pp. 52–55.) An oscillator giving high frequency stability and using relatively few components is based on a cathode-coupled Hartley circuit with resistance in the cathode lead.

621.373.421.13 **1002**

The Measure of Activity of Oscillators and the Performance Index.—W. Herzog. (*Arch. elekt. Übertragung*, Oct. 1953, Vol. 7, No. 10, pp. 470–472.) The measure of activity of an oscillator is defined as the ratio of grid-voltage amplitude to anode-current amplitude. In crystal-controlled oscillators it is proportional to the crystal performance index. The measure of activity is evaluated for several common types of oscillator.

621.373.424.029.4 **1003**

Design of Heterodyne Oscillators.—H. Lennartz. (*Funk u. Ton*, Oct. 1953, Vol. 7, No. 10, pp. 526–534.) The choice of frequencies for producing a given beat frequency, and the design of the variable tuning capacitor are considered. Precautions required to ensure frequency stability are discussed.

621.373.43 **1004**

The Operation of Generators for Steep-Fronted Waves.—J. Lagasse, J. Favarel & P. Sido. (*C. R. Acad. Sci., Paris*, 9th Nov. 1953, Vol. 237, No. 19, pp. 1151–1152.) When the self-inductance of the generator is taken into account in the analysis, a third-order differential equation is obtained; simplification is introduced by taking advantage of a particular solution. Graphical methods of investigation, based on the work of Bergeron, are also outlined.

621.373.52 **1005**

Transistor Oscillator for Use in Multifrequency Pulsing Current Supply.—F. E. Blount. (*Bell Syst. tech. J.*, Nov. 1953, Vol. 32, No. 6, pp. 1313–1331.) Discussion of an oscillator for use in the transmission of digital information, at frequencies in the band 700–1 700 c/s, over telephone trunk-lines. Performance details are given.

621.374 : 621.318.572 **1006**

Introduction to the Use of Electronic Tubes in Pulse Techniques.—P. A. Neeteson. (*Electronic Applic. Bull.*, June/July 1953, Vol. 14, Nos. 6/7, pp. 102–112.) Circuit phenomena produced by switching are briefly reviewed and the operation of valves as nonlinear or switching elements is discussed as an introduction to the consideration of some well known pulse circuits.

621.374.33 **1007**

A Special Time-Discriminating Selector for Electronic Pulses.—A. Alberigi, F. Lepri & G. Stoppini. (*Nuovo Cim.*, 1st April 1952, Vol. 9, No. 4, pp. 365–368.) A circuit is described which is able to select the last of a series comprising an arbitrary number of pulses distributed in an arbitrary way within a fixed time interval.

621.375.1 : 621.396.822 **1008**

Determination of the Noise Factor of Various Amplifiers by a Comparison Method.—W. Mansfeld. (*Funk u. Ton*, Oct. 1953, Vol. 7, No. 10, pp. 501–507.) The relative noise factor can be determined by using a standard-type signal generator connected to the input of the amplifier and a band-pass filter coupled to a valve voltmeter at the output.

621.375.232 **1009**

Wide-Band I.F. Amplifiers.—H. S. Jewitt. (*Wireless World*, Feb. 1954, Vol. 60, No. 2, pp. 86–90.) Bandwidths $>$ 10 Mc/s, such as are required for dealing satisfactorily with very short pulses, are achieved without necessitating alignment of the amplifier with a particular set of valves, by using a negative-feedback design technique. The amplifier is treated as a series of pairs of valves, the first of each pair operating without and the second with feedback. A table gives component values in a form requiring a minimum of computation. A particular 12-stage amplifier designed by this method for a centre frequency of 60 Mc/s had a bandwidth of 20 Mc/s to the -1db points and an overall gain of about 90 db; the response varied only very slightly when all the valves were changed.

621.375.3 **1010**

Magnetic Amplifier uses Conventional Inductors.—A. I. Bennett, Jr. (*Electronics*, Jan. 1954, Vol. 27, No. 1, pp. 181–183.)

621.375.3 **1011**

Negative Inductance cuts Magnetic-Amplifier Lag.—G. M. Ettinger. (*Electronics*, Jan. 1954, Vol. 27, No. 1, pp. 162–163.) The speed of response of a magnetic amplifier is improved, without reducing its sensitivity, by balancing out the effect of control-circuit inductance by means of a 'negative-inductance' device comprising a valve with an iron-cored mutual inductor.

621.375.3.024 **1012**

The Design of a Practical D.C. Amplifier Based on the Second-Harmonic Type of Magnetic Modulator.—S. W. Noble & P. J. Baxandall. (*Proc. Instn elect. Engrs*, Part II, Oct. 1953, Vol. 100, No. 77, pp. 567–570.) Discussion on 72 of 1953.

621.375.4 **1013**

Transistors: Theory and Application: Part 11—Cascading Transistor Amplifier Stages.—A. Coblenz & H. L. Owens. (*Electronics*, Jan. 1954, Vol. 27, No. 1, pp. 158–161.) Formulae and values of circuit parameters are tabulated for various possible arrangements using point-contact or junction transistors.

621.375.4.029.3 : 621.314.7 **1014**

Power Transistors for Audio Output Circuits.—Giacoletto. (See 1247.)

621.396.822 : 621.372 **1015**

Physical Basis of Thermal Noise.—D. A. Bell. (*Wireless Engr*, Feb. 1954, Vol. 31, No. 2, pp. 48–50.) An examination is made of methods developed by various workers for analysing circuit noise due to random motion of charge carriers. It is concluded that it is not necessary to postulate thermodynamic equilibrium in order to be able to calculate the thermal noise.

621.375.4 + 621.373.52 **1016**

Principles of Transistor Circuits. [Book Review]—R. F. Shea (Ed.). Publishers, Chapman & Hall, London, 535 pp., 88s. (*Wireless Engr*, Feb. 1954, Vol. 31, No. 2, pp. 51–52.) A comprehensive work on transistors and their circuitry, written by nine members of the staff of the electronics laboratory of the G.E.C. Company of America.

621.376 + 621.314.26 **1017**

Modulators and Frequency Changers. [Book Review]—D. G. Tucker. Publishers: Macdonald & Co., London, 232 pp., 28s. (*Brit. J. appl. Phys.*, Oct. 1953, Vol. 4, No. 10, p. 319.) For research, development and maintenance engineers. High-power transmitting modulators are not treated.

GENERAL PHYSICS

534.014.5 **1018**

Graphical Presentation of Oscillator Resonance, Applicable to the Study of Nonlinear Systems.—P. Liénard. (*Acustica*, 1953, Vol. 3, No. 4, pp. 212–223. In French.)

535.31 : 535.13 **1019**

Derivation of the Laws of Geometrical Optics from Maxwell's Field Theory.—G. Mandl. (*Acta phys. austriaca*, Sept. 1953, Vol. 7, No. 4, pp. 365–389.)

535.42 : 538.56 : 621.372.8 **1020**

The Diffraction of Electromagnetic Waves by a Semi-infinite Circular Waveguide.—J. D. Pearson. (*Proc. Camb. phil. Soc.*, Oct. 1953, Vol. 49, Part 4, pp. 659–667.) Formulae are obtained for the currents on the waveguide, and asymptotic expressions are derived for the longitudinal components of the electric and magnetic vectors in the waveguide at large distances from the mouth.

537.122 : 538.56 **1021**

A Collective Description of Electron Interactions: Part 2 — Collective vs Individual Particle Aspects of the Interactions.—D. Pines & D. Bohm. (*Phys. Rev.*, 15th Jan. 1952, Vol. 85, No. 2, pp. 338–353.) Part 1: 2975 of 1951.

537.221 : 546.47 **1022**

The Electromotive Force developed by a Creeping Zinc Crystal.—F. D. Coffin & S. L. Simon. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1333–1334.)

537.311.1 **1023**

Theory of Plasma Waves in Metals.—P. A. Wolff. (*Phys. Rev.*, 1st Oct. 1953, Vol. 92, No. 1, pp. 18–23.) The Hartree approximation is used to investigate the effect of the crystal lattice on plasma oscillations in metals. A formula is derived for the oscillation frequency; for free electrons this reduces to that given by Bohm & Gross (88 and 89 of 1950); for insulators there are no oscillations. In metals with occupied d bands there is strong coupling between the plasma oscillations and the d electrons, causing frequency broadening.

537.311.33 **1024**

Theory of A.C. Space-Charge Polarization Effects in Photoconductors, Semiconductors, and Electrolytes.—J. R. MacDonald. (*Phys. Rev.*, 1st Oct. 1953, Vol. 92, No. 1, pp. 4–17.) Linear theory is developed for solid or

liquid materials containing charge carriers which can move freely within the material but are blocked by the electrodes. The carriers may be electrons, holes, ions or ion vacancies. The general solution for the admittance of the material is obtained for an arbitrary ratio between the mobilities of positive and negative carriers, and is discussed for some special cases. Results are compared with those derived from other theories.

537.525.5 **1025**

The Field-Emission-Initiated Vacuum Arc: Part 1 — Experiments on Arc Initiation.—W. P. Dyke, J. K. Trolan, E. E. Martin & J. P. Barbour. (*Phys. Rev.*, 1st Sept. 1953, Vol. 91, No. 5, pp. 1043–1054.) The experiments were carried out under conditions of high vacuum and clean cathode surface. Results show (*a*) that breakdown is immediately preceded by recognizable emission anomalies, (*b*) that breakdown occurs at a critical current density of the order of 10^8 A/cm², for applied microsecond pulses in the range 8·8–60·1 kV, and (*c*) that breakdown is independent of cathode bombardment.

537.525.5 **1026**

The Field-Emission-Initiated Vacuum Arc: Part 2 — The Resistively Heated Emitter.—W. W. Dolan, W. P. Dyke & J. K. Trolan. (*Phys. Rev.*, 1st Sept. 1953, Vol. 91, No. 5, pp. 1054–1057.) Theory is developed for the heat flow in an emitter of geometry approximating to that used in the experiments reported in 1025 above. The calculations support the view that breakdown is initiated by a resistive heating process.

537.533 : 537.525.92 **1027**

Space-Charge Effects in Field Emission.—J. P. Barbour, W. W. Dolan, J. K. Trolan, E. E. Martin & W. P. Dyke. (*Phys. Rev.*, 1st Oct. 1953, Vol. 92, No. 1, pp. 45–51.) "A progressive reduction of the observed field current below values expected from the empirical law for increasing values of the potential is attributed to space charge. The current density expected in the presence of space charge is calculated from the Fowler-Nordheim field emission theory using values of the cathode electric field obtained from a solution of Poisson's equation for plane electrodes with boundary conditions appropriate to field emission. The result is a generalization of Child's equation, and is asymptotic to it when the applied potential is large compared with the value required for appreciable field emission."

537.533 : 538.691 **1028**

"Brillouin Flow" with Thermal Velocities.—J. R. Pierce & L. R. Walker. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1328–1330.) "A type of electron flow in a constant magnetic field is described. The beam of electrons is supposed to be everywhere in thermal equilibrium and the usual Brillouin flow is found when the equilibrium temperature tends to zero. Some considerations are put forward bearing on the choice of a suitable beam temperature in specific problems."

537.533.8 **1029**

A Modified Theory of Production of Secondary Electrons in Solids.—A. van der Ziel. (*Phys. Rev.*, 1st Oct. 1953, Vol. 92, No. 1, pp. 35–39.) Difficulties in previous theories of energy loss and secondary-electron production in metals [see e.g. 3069 of 1952 (Dekker & van der Ziel)] are removed by replacing the Coulomb interaction between a primary electron and a lattice electron by a screened Coulomb interaction.

537.56 : 538.63 **1030**

Magneto-ionic Theory of Weakly Ionized Gases in the Presence of an Oscillating Electric Field and a Constant Magnetic Field.—R. Jancel & T. Kahan. (*J. Phys. Radium*, Oct. 1953, Vol. 14, No. 10, pp. 535–540.) The velocity distribution functions for a nonuniformly ionized gas are calculated by solving the Boltzmann differential equations. Explicit expressions are derived for the magneto-ionic conductivity, the dielectric tensor, the Hall effect, the deflection of the electron beam and the generalization of Langevin's mobility formula. Comparison is made with other methods of calculation.

537.562 : 538.63 **1031**

The Conductivity Tensor of Electron Plasmas in the presence of a Constant Magnetic Field.—M. Bayet, J. L. Delcroix & J. F. Denisse. (*C. R. Acad. Sci., Paris*, 9th Dec. 1953, Vol. 237, No. 23, pp. 1503–1505.) Assuming the mean collision frequency to be independent of velocity, it is shown that the form of the conductivity tensor given by Jancel & Kahan (1030 above) differs from that given by Huxley (1266 of 1952). In order to represent the magnetoresistance terms correctly by Jancel & Kahan's method, closer approximation is necessary.

538.22 **1032**

Some Magnetic Properties of Metals: Part 6 — Surface Corrections of the Landau Diamagnetism and the de Haas-van Alphen Effect.—R. B. Dingle. (*Proc. roy. Soc. A*, 7th Oct. 1953, Vol. 219, No. 1139, pp. 463–477.) An expression is given for the magnetic moment of a large but finite system of electrons in terms of the volume and two mutually perpendicular surface areas together with constants independent of the shape of the system. The theory is verified by calculating the values of the constants for two different shapes. Corrections to part 5 (1967 of 1953) are noted.

538.221 **1033**

A Two-Electron Example of Ferromagnetism.—J. C. Slater, H. Statz & G. F. Koster. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1323–1341.) The method of dealing with problems of ferromagnetism on the basis of energy-band theory [*Rev. mod. Phys.*, 1953, Vol. 25, p. 199 (Slater)] is applied to a simple case.

538.51 **1034**

The Law of Induction.—G. Vallauri. (*Alta Frequenza*, Oct. 1953, Vol. 22, No. 5, pp. 211–238.) A survey of the literature indicates a lack of clarity on this subject. The law of induction is formulated generally in terms of a geometrical entity called the 'flux line', which exists in the field of a solenoidal vector.

538.52 **1035**

Induction Phenomena consequent on the Movement of Material in Primary Magnetic Fields, and their Experimental Applications: Part 3 — Fundamental Theory for Very General Cases.—H. Hinteregger. (*Acta phys. austriaca*, Sept. 1953, Vol. 7, No. 4, pp. 337–354.) Theory applicable to any type of motion is developed. Part 2: 388 of March.

538.561 : 537.533 **1036**

Motion of an Electron in a Magnetic Undulator.—R. Combe & M. Feix. (*C. R. Acad. Sci., Paris*, 23rd Nov. 1953, Vol. 237, No. 21, pp. 1318–1320.) Rigorous solutions are obtained for the equations of motion of an electron in a millimetre-wave generator of the type described by Motz et al. (3582 of 1953).

538.561 : 537.533 **1037**

Frequencies and Power of Waves Radiated by a Magnetic Undulator.—R. Combe & M. Feix. (*C. R. Acad. Sci., Paris*, 21st Dec. 1953, Vol. 237, No. 25, pp. 1660–1662.) Continuation of investigation noted in 1036 above. The dimensions of an undulator for

generating mm waves are determined from rigorous calculations of electron trajectories. The results differ greatly from values derived from classical theory. The values found for radiated power are of the same order.

538.566 : 537.56 **1038**

The Equations of Propagation of Electromagnetic Waves in an Ionized Gas.—A. M. Confetta. (*R. C. Ist. lombardo*, 1952, Vol. 85, No. 2, pp. 495–502.) Two different methods are used to derive the equations for the propagation of e.m. waves in an ionized gas subjected to a time-varying e.m. field and to a constant magnetic field; terms depending on past states are found to occur.

538.566.029.64 : 535.51-7 **1039**

Effect of a Metal Plate on Total Reflection.—W. Culshaw & D. S. Jones. (*Proc. phys. Soc.*, 1st Oct. 1953, Vol. 66, No. 406B, pp. 859–864.) The phase changes which occur on total reflection are modified when a metal plate is placed near and parallel to the reflecting boundary. By moving the plate, the phase difference between plane waves of equal amplitudes polarized in and perpendicular to the plane of incidence can be varied from $-\pi$ up to the positive value obtained without the plate. This has been confirmed experimentally using a wavelength of 1·25 cm and a 45° perspex prism. When the refractive index is $\geqslant 1+\sqrt{2}$, there are two positions of the plate for which the reflected wave is circularly polarized, the electric vector rotating in opposite directions for these two positions.

538.566.2 **1040**

Theory of a [linear] **Conductor near the Boundary of Two Media.**—A. A. Pistol'kors. (*C. R. Acad. Sci. U.R.S.S.*, 11th Oct. 1952, Vol. 86, No. 5, pp. 941–943. In Russian.) The electromagnetic field due to an oscillation of angular frequency ω in the conductor can usually be split into two components; a cylindrical-wave field and a spherical-wave field. Near the axis of the conductor, which is parallel to the boundary plane, the field is of a special type. The condition for the existence of the two components is derived and applied to particular cases.

538.691 **1041**

Deflection of High-Energy Electrons in Magnetized Iron.—S. Berko & F. L. Hereford. (*Phys. Rev.*, 1st Sept. 1953, Vol. 91, No. 5, pp. 1127–1130.) The effective magnetic field acting on electrons traversing a ferromagnetic medium is shown, by experiments, to be equal to the flux density.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.5 : 621.396.96 **1042**

Radio Echo Studies of Meteor Ionization.—T. R. Kaiser. (*Advances Phys.*, Oct. 1953, Vol. 2, No. 8, pp. 495–544.) The physical properties of the meteors and the columns of ionization which they produce, and the properties of the atmosphere in the meteor ionization region were investigated using, mainly, pulse equipment operating in the 4–10-m waveband. The development of a satisfactory theory of scattering of radio waves from meteor trails, together with the theory of evaporation from meteors, makes possible the detailed interpretation of the radio echoes obtained. In particular, the estimated incident flux of meteors is found to be sufficient to maintain a continuous ionospheric layer extending from ~130 km down to 115 km, below which ionization will be distributed in patches becoming fewer (and larger) with decreasing height. Over 40 references.

523.72 : 621.396.822 **1043**

Observations of Solar Radio-Noise Storms.—B. Vauquois, P. Coupiac & M. Laffineur. (*C. R. Acad. Sci., Paris*, 21st Dec. 1953, Vol. 237, No. 25, pp. 1630–1632.) Observations indicate that simple storms, i.e. those caused by a single bipolar group of sunspots, exhibit a directional effect varying with wavelength.

523.745 : 621.396.822.029.62 **1044**

Radio Noise Bursts from Solar *M*-Regions.—A. K. Das & B. N. Bhargava. (*Nature, Lond.*, 7th Nov. 1953, Vol. 172, No. 4384, pp. 855–856.) The passage of *M*-regions is characterized by a notable increase in the short-term variability of noise intensity at 3 m λ.

523.755 : 537.56 **1045**

Ionization and Recombination Processes in a Plasma and the Ionization Formula of the Solar Corona.—G. Elwert. (*Z. Naturf.*, June 1952, Vol. 7a, No. 6, pp. 432–439.) For a plasma not in thermodynamic equilibrium, formulae are derived for (*a*) the photo-ionization, (*b*) the ionization by collisions, (*c*) the recombination with emission of light, and (*d*) the recombination due to triple collisions. By equating the number of collision ionizations with the number of photorecombinations, an ionization formula is obtained for the solar corona from which the temperature of the corona can be estimated.

523.852 : 621.396.822.029.62 **1046**

Radio-Frequency Radiation from the Spiral Nebula Messier 81.—R. H. Brown & C. Hazard. (*Nature, Lond.*, 7th Nov. 1953, Vol. 172, No. 4384, p. 853.) The intensity measurement of the radio source observed has been combined with previous observations to determine the ratio between the radio flux and the light flux for individual nebulae. The calculated flux from a nebula of apparent magnitude $+10$ (Shapley-Ames) is $\sim 4{\cdot}2 \times 10^{-26}$ W/m²/(c/s) at 158·5 Mc/s.

523.852.3 : 621.396.822 **1047**

An Extended Radio-Frequency Source of Extragalactic Origin.—R. H. Brown & C. Hazard. (*Nature, Lond.*, 28th Nov. 1953, Vol. 172, No. 4387, pp. 997–998.) Extension of observations noted in 2215 of 1952.

550.3 : 519.2 **1048**

Statistical Analysis of Geophysical Time Series.—R. P. W. Lewis & D. H. McIntosh. (*Met. Mag., Lond.*, Aug. 1953, Vol. 82, No. 974, pp. 239–242.) Notes are provided on dealing with the effects of linear and periodic trends on standard deviation and correlation coefficient. Significant tests in coherent series are discussed.

550.384 **1049**

The Phased-Superposed-Epoch Method of Analysis, and an Application to Geomagnetic Activity.—E. J. Chernosky. (*Trans. Amer. geophys. Union*, Aug. 1953, Vol. 34, No. 4, pp. 519–528.) A method is described in which geomagnetic-activity variations are analysed by grouping the data according to their phases (increasing, decreasing, or no-change), as determined by considering the characteristics for pairs of successive days.

550.384 : 523.74/.75 **1050**

Geomagnetic Activity and the Sunspot Cycle.—R. Ananthakrishnan. (*Nature, Lond.*, 7th Nov. 1953, Vol. 172, No. 4384, pp. 854–855.) A table is given, for the last four sunspot-maximum epochs, of the numbers of magnetically calm days and of slightly, moderately and highly disturbed days, together with sunspot numbers and a measure of the prominence activity. Geomagnetic activity shows correlation with prominence activity rather than with sunspot activity.

550.384.4 **1051**

Diurnal Magnetic Variations near the Magnetic Equator.—S. K. Pramanik & P. S. Hariharan. (*Indian J. Met. Geophys.*, Oct. 1953, Vol. 4, No. 4, pp. 353–358.) Observations made at nine places in South India are analysed in conjunction with observations for South America. High diurnal ranges of H occur in a belt of 5°–6° of latitude, with a maximum near the magnetic equator.

551.510.535 **1052**

Abnormal Ionospheric Absorption observed during February 1952.—R. Eyfrig. (*Ann. Géophys.*, Oct./Dec. 1953, Vol. 9, No. 4, pp. 325–327.) Observations from stations all over the world are analysed. Very high absorption was observed during the period 24th–28th February within a limited region. The eastern and western limits of the affected region are not known accurately, because of the sparseness of stations; no effect was observed in America or in the Far East. The southern limit was observed in Africa, roughly along the line joining Casablanca and Djibouti. An explanation involving corpuscular radiation fits the observations better than one based directly on wave radiation from the sun. The absorption is thought to occur in low-altitude ionized layers such as that detected by Gnanalingam & Weekes (3427 of 1952).

551.510.535 **1053**

A Self-Consistent Calculation of the Dissociation of Oxygen in the Upper Atmosphere: Part 2 — Three-Body Recombinations.—H. E. Moses & Ta-You Wu. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1408–1409.) Continuation of work noted in 102 of 1953. Results based on the assumption that recombination occurs mainly as a three-body nonradiative process indicate that dissociation occurs at a level about 5 km higher than that previously calculated.

551.510.535 **1054**

Bifurcation of the E Region.—J. R. Lien, R. J. Marcou, J. C. Ulwick, D. R. McMorrow, D. B. Linsford & O. C. Haycock. (*Phys. Rev.*, 15th Oct. 1953, Vol. 92, No. 2, pp. 508–509.) The retardation time, relative to an u.h.f. reference signal, of a radio signal of frequency about 1 Mc/s above the critical frequency was measured by rocket-borne instruments. Electron-density/altitude graphs were derived from the retardation-time/time-of-flight records; bifurcation of the E layer is clearly indicated. The results are in close agreement with those calculated from records obtained with the N.B.S. Model C-3 ionosphere recorder. The separation of the electron-density maxima was 13–18 km.

551.510.535 **1055**

Direction-Finding Studies of Large-Scale Ionospheric Irregularities.—E. N. Bramley. (*Proc. roy. Soc. A*, 22nd Oct. 1953, Vol. 220, No. 1140, pp. 39–61.) Continuation of work noted in 3091 of 1951 (Bramley & Ross). A report is given of measurements on pulse-modulated transmissions in the frequency range 2–15 Mc/s, reflected from the ionosphere. Both vertical-incidence and oblique-incidence observations were made. The directional variations of the reflected signals were studied, and are interpreted as due to tilting or wrinkling of the constant-ionic-density surfaces in the ionosphere. The results indicate large-scale horizontal movements in the ionosphere. In the E_s layer these appear to be of the nature of drifting clouds of ionization, while in the F layer the effects are consistent with horizontally travelling ripples having wavelengths of 50–400 km and speeds up to 350 m/s. The direction of motion is more often towards east or west than towards north or south, and evidence of a diurnal variation has been observed.

551.510.535 **1056**

Reflexions from Irregularities in the Ionosphere.—G. H. Munro. (*Proc. roy. Soc. A*, 7th Oct. 1953, Vol. 219, No. 1139, pp. 447–463.) Complexities in records of $h't$ and $h'f$ for the F region are shown to be due to curvature of the reflecting surface. The order of curvature associated with travelling disturbances is calculated and the variation in the type of complexity is shown to result from differing group retardations in the different paths. A 50-km-base triangular system of three 5·8-Mc/s pulse-transmitters, and a panoramic type 1–15-Mc/s recorder were used respectively for $h't$ and $h'f$ recording.

551.510.535 **1057**

Examination of the Formation of the Ionosphere F Region.—K. Rawer & E. Argence. (*Ann. Géophys.*, Jan./March 1953, Vol. 9, No. 1, pp. 1–25.) Continuation of work noted in 987 of 1952 (Rawer et al.). Two different possible mechanisms are discussed, namely (*a*) photo-ionization of O_2, and (*b*) ionization by soft X rays. The photoionization hypothesis is only acceptable if the dissociation of the O_2 is assumed to take place at a relatively high altitude of about 130 km. Ionization by X rays of solar origin certainly occurs, but a recent calculation of the spectral distribution of solar energy indicates too high an ionization at 95–110 km.

551.510.535 **1058**

Recombination Coefficient in the F-Regions: a Possible New Process of Ionization of Nitrogen Molecules.—R. B. Banerji. (*Nature, Lond.*, 21st Nov. 1953, Vol. 172, No. 4386, pp. 953–954.) Discussion of a possible dissociative recombination process according to which the daytime solar radiation at visible wavelengths may be instrumental in ionizing nitrogen molecules if positively charged particles are present.

551.510.535 : 523.78 **1059**

The Solar Eclipse of 25-2-1952 at Gao.—F. Delobeau. (*Ann. Géophys.*, Oct./Dec. 1953, Vol. 9, No. 4, pp. 317–324.) Ionosphere observations made during the eclipse are reported. Though the occultation was only partial, a diminution of E- and F_2-layer ionization compared with normal days was observed; the effect was very pronounced at 0735 hours U.T., when the sunspot near the western limb of the sun was obscured. On the other hand, when this sunspot disappeared on 26th February, as a result of the rotation of the sun, there was no noticeable reduction of the E-layer ionization. The effect is difficult to explain in terms of classical theory. The diminution of ionization of the F_2 layer is significant.

551.510.535 "1953" : 621.396.11 **1060**

Ionosphere Review: 1953.—T. W. Bennington. (*Wireless World*, Feb. 1954, Vol. 60, No. 2, pp. 66–68.) Twelve-month running averages and monthly-mean values are plotted for the sunspot numbers and the noon and midnight F_2 critical frequencies from 1947. It is inferred that the critical frequencies are likely to decrease only very slightly before the next sunspot minimum, and that the latter is to be expected between March 1954 and April 1955.

551.594 : 621.317.72 **1061**

The Agrimeter for Continuous Recording of the Atmospheric Electric Field.—J. A. Chalmers. (*J. atmos. terr. Phys.*, Oct. 1953, Vol. 4, No. 3, pp. 124–128.) Description of an instrument based on measurement of the 'bound' charge on a portion of the earth's surface.

551.594.221 **1062**

The Pilot Streamer in Lightning and the Long Spark.—B. F. J. Schonland. (*Proc. roy. Soc. A*, 22nd Oct. 1953, Vol. 220, No. 1140, pp. 25–38.)

551.594.221 : 621.396.969.029.63 **1063**

The Study of Lightning Streamers with 50 cm Radar.—F. J. Hewitt. (*Proc. phys. Soc.*, 1st Oct. 1953, Vol. 66, No. 406 B, pp. 895–897.) Radar echoes were observed during the whole period between the successive strokes in a lightning flash. Some components of these echoes appear to be associated with the processes leading up to the next stroke. Photographic c.r.o.-trace records of the stroke, at its commencement and 12 ms later, are reproduced and discussed.

551.594.6 **1064**

Methods of Synchronizing the Observations of a "Sferics" Network.—A. L. Maidens. (*Met. Mag., Lond.*, Sept. 1953, Vol. 82, No. 975, pp. 267–270.) Methods in use in the British network are described.

LOCATION AND AIDS TO NAVIGATION

621.396 : 551.594.6 **1065**

The Reception of Atmospherics at High Frequencies.—F. Horner. (*J. atmos. terr. Phys.*, Oct. 1953, Vol. 4, No. 3, pp. 129–140.) Report on h.f. atmospheric-noise observations made at a single point (Teddington) with a view to assessing the practical possibility of basing estimation of source distances on them. Atmospherics were recorded simultaneously at two frequencies in the upper part of the h.f. band, and the source identity was checked from c.r.d.f. data. Observations were expected to, and generally did, exhibit the following features: (*a*) reception at both frequencies from sources within ground-wave range; (*b*) no reception when the observation station lies in the skip zone for both frequencies; (*c*) reception on either the lower frequency or both frequencies, according as the observation station lies beyond the skip zone either for the lower frequency or for both frequencies. Difficulties of the method and results achieved are discussed.

621.396.96 **1066**

Theoretical Performance of Airborne Moving Target Indicators.—F. R. Dickey, Jr. (*Trans. Inst. Radio Engrs*, June 1953, No. PGAE-8, pp. 12–23.) Fluctuations in the strength of echoes from fixed objects, due to the movement of the aerial, are considered and simple formulae developed to facilitate ground clutter attenuation calculations. The expression for the ratio of mean-square voltage change between two successive signals received from the ground to the mean-square signal voltage is the sum of four terms, one involving rotation, and the other three the displacement components. Each term is developed in a power series, three different beam shapes being taken into account.

621.396.96 : 621.396.677.859 **1067**

Designing Radomes for Supersonic Speeds.—S. S. Oleesky. (*Electronics*, Jan. 1954, Vol. 27, No. 1, pp. 130–135.) Designs which will not attenuate or distort the radar beam are discussed.

621.396.963.325 **1068**

A High-Definition General-Purpose Radar.—J. W. Jenkins, J. H. Evans, G. A. G. Wallace & D. Chambers. (*J. Brit. Instn Radio Engrs*, Jan. 1954, Vol. 14, No. 1, pp. 5–21. Discussion, pp. 21–23.) A detailed description is given of equipment for operation in the 3-cm waveband; it is compact enough to be mobile, and can be used with only minor modifications for local aircraft control, airfield surface-movement control, harbour control, etc. Variable pulse width and automatically centering time-base are used. The paraboloid aerial reflector is moulded from a plastic of good dimensional stability. P.p.i. display is given on two 15-in. tubes.

621.396.969 **1069**

Some Possible Reductions in Gust Loads through Use of Radar in Transport Airplanes.—H. B. Tolefson. (*Bull. Amer. met. Soc.*, May 1953, Vol. 34, No. 5, pp. 187–191.) Analysis of turbulence measurements made in different weather conditions indicates that a 10% reduction of the magnitude of the largest gust loads might be achieved, but that little if any reduction of loads due to the more numerous weak gusts is to be expected from the use of airborne radar to detect storm areas. Passenger comfort could be appreciably increased. The use of contour radar is desirable for selecting the smoothest path through storm areas that cannot be avoided.

MATERIALS AND SUBSIDIARY TECHNIQUES

535.371 **1070**

Fluorescence, Phosphorescence, and Photostimulation of NaCl(AgCl) with High-Energy Irradiation.—M. Furst & H. Kallmann. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1356–1367.)

537.224 **1071**

Studies of the Heterocharges of Electrets.—S. Wikström. (*Ericsson Tech.*, 1953, Vol. 9, No. 2, pp. 225–234.) Report of investigations of the dependence of the charging and discharging rate on temperature, the influence of a d.c. field at room temperature on a prepared electret, the influence of pressure during charging and discharging, and the influence of polarization on the capacitance and loss angle.

537.226 : [546.48.882.5 + 546.817.882.5 **1072**

Dielectric Properties and Phase Transitions of $Cd_2Nb_2O_7$ and $Pb_2Nb_2O_7$.—G. Shirane & R. Pepinsky. (*Phys. Rev.*, 15th Oct. 1953, Vol. 92, No. 2, p. 504.) Measurements were made at temperatures down to 40°K, at a frequency of 10 kc/s and a field strength of 5 V/cm. The dielectric constant of cadmium niobate, which is 310 at room temperature, rises to a maximum of 1 200 at 185°K, the Curie point. The corresponding constants for lead niobate are 185 and 360 (at 14°K) respectively. Ferroelectric-type hysteresis and a dielectric constant anomaly at 85°K were observed in the former material only.

537.226 : [546.48.882.5 + 546.817.882.5 **1073**

Low-Temperature Dielectric Properties of Cadmium and Lead Niobates.—J. K. Hulm. (*Phys. Rev.*, 15th Oct. 1953, Vol. 92, No. 2, pp. 504–505.) The results of measurements at temperatures down to 1·2°K, at 1 kc/s and 10 V/cm, are similar to those reported by Shirane & Pepinsky (1072 above).

537.311.1 **1074**

Changes in the Electrical, Thermal, and Thermoelectrical Properties of Monovalent Metals by Lattice Distortions.—A. W. Sáenz. (*Phys. Rev.*, 1st Sept. 1953, Vol. 91, No. 5, pp. 1142–1151.) A transport equation is derived for the distribution of conduction electrons in monovalent metals with static lattice distortions, simple assumptions regarding interaction energy being made. Using an iteration method, and considering temperatures very much higher than the Debye temperature of the lattice, a set of integral equations is obtained and solved explicitly. General expressions are found for the resistivity, thermal conductivity and absolute thermoelectric power tensors and are applied to specific calculations for a metal having an array of parallel positive-negative edge dislocations.

537.311.33 : 538.632 **1075**

Current Carrier Lifetimes Deduced from Hall Coefficient and Resistivity Measurements.—L. P. Hunter, E. J.

Huibregtse & R. L. Anderson. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1315–1320.) A method for determining the lifetime of charge carriers in semiconductors, based on theory presented by Landauer & Swanson (165 of January), gives results in reasonable agreement with those obtained on the same samples by injection methods.

537.311.33 : 546.23 **1076**

Anisotropic Resistivities of Selenium Crystals at High Frequencies.—H. W. Henkels & J. Maczuk. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1562–1563.) Some measurements are reported; results are compared with values obtained previously.

537.311.33 : 546.23 **1077**

The Structure of Amorphous Selenium.—H. Richter, W. Kulcke & H. Specht. (*Z. Naturf.*, Aug. 1952, Vol. 7a, No. 8, pp. 511–532.) A study of the amorphous material, prepared in various ways, and of its transition to the crystalline state.

537.311.33 : 546.26-1 **1078**

The Electrical Resistance of Graphite at Low Temperatures.—J. M. Reynolds, H. W. Hemstreet & T. E. Leinhardt. (*Phys. Rev.*, 1st Sept. 1953, Vol. 91, No. 5, pp. 1152–1155.) The resistance of large-crystal natural graphite increases with increasing temperatures from 1·35°K to room temperature. That of polycrystalline graphite decreases over practically the whole of this range; at 5°K it is nearly independent of temperature.

537.311.33 : [546.28 + 546.289 **1079**

Electron Multiplication in Silicon and Germanium.—K. G. McKay & K. B. McAfee. (*Phys. Rev.*, 1st Sept. 1953, Vol. 91, No. 5, pp. 1079–1084.) "Electron multiplication in silicon and germanium has been studied in the high fields of wide p-n junctions for voltages in the prebreakdown region. Multiplication factors as high as eighteen have been observed at room temperature. Carriers injected by light, alpha particles, or thermal-generation are multiplied in the same manner. The time required for the multiplication process is less than 2×10^{-8} second. Approximately equal multiplication factors are obtained for injected electrons and injected holes. The multiplication increases rapidly as 'breakdown voltage' is approached. The data are well represented by ionization rates computed by conventional avalanche theory. In very narrow junctions, no observable multiplication occurs before Zener emission sets in, as previously reported. It is incidentally determined that the efficiency of ionization by alpha particles bombarding silicon is $3{\cdot}6 \pm 0{\cdot}3$ electron volts per electron-hole pair produced."

537.311.33 : 546.28 **1080**

Paramagnetic Resonance in *N*– and *P*–Type Silicon.—F. K. Willenbrock & N. Bloembergen. (*Phys. Rev.*, 1st Sept. 1953, Vol. 91, No. 5, p. 1281.) Experiments were performed at 9 kMc/s at 78°K. The absorption signal was roughly proportional to impurity concentration.

537.311.33 : 546.289 **1081**

Absorption of Infrared Light by Free Carriers in Germanium.—H. B. Briggs & R. C. Fletcher. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1342–1346.) Measurements were made of the radiation absorbed when free carriers were injected across a p-n junction; the absorption was proportional to the carrier concentration. The absorption/wavelength curve exhibits the maxima previously observed in ordinary p-type Ge; the positions of these maxima depend on temperature. An explanation of the observations based on degenerate energy bands is advanced.

537.311.33 : 546.289 **1082**

Infrared Absorption in *P*-Type Germanium.—W. Kaiser, R. J. Collins & H. Y. Fan. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1380–1381.) Measurements made at temperatures down to 5°K indicate that the absorption coefficient is proportional to the hole concentration. There is a strong absorption band above 10 μ, caused by excitations within the filled band due to the presence of holes, and two weaker bands at shorter wavelengths, one of which disappears at low temperatures.

537.311.33 : 546.289 **1083**

Optical Studies of Injected Carriers: Part 1 — Infrared Absorption in Germanium.—R. Newman. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1311–1312.) Measurements were made of the amount of radiation transmitted through a p-n-junction Ge diode into which carriers were injected in pulses. The results indicate that for injection into low-resistivity material (p-type) the injection current is proportional to the injected carrier density, while for injection into high-resistivity material (n-type) there is a departure from proportionality.

537.311.33 : 546.289 **1084**

Optical Studies of Injected Carriers: Part 2 — Recombination Radiation in Germanium.—R. Newman. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1313–1314.) Measurements were made of the radiation produced by direct recombination of electrons and holes in p-n-junction Ge diodes into which carriers were injected in pulses. The observed spectral distribution is in fair agreement with theory. The intensity of radiation is proportional to the injection current for both high- and low-resistivity material. Polarization of the radiation at oblique angles of emergence was observed.

537.311.33 : 546.289 **1085**

Surface Recombination in Germanium.—W. N. Reynolds. (*Proc. phys. Soc.*, 1st Oct. 1953, Vol. 66, No. 406B, pp. 899–901.) The variation of the surface recombination velocity of injected minority carriers with temperature was determined for five different surfaces. The absolute values were found to be very sensitive to changes in the etching procedure.

537.311.33 : 546.289 **1086**

Electrical Conductivity of Mechanically Disturbed Germanium Surfaces.—E. N. Clarke & R. L. Hopkins. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1566–1567.) Experiments indicate that the effect of polishing, sandblasting, etc., is to produce a surface layer of relatively high conductivity.

537.311.33 : 546.289 **1087**

Microwave Observation of the Collision Frequency of Holes in Germanium.—T. S. Benedict. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1565–1566.) Using the technique previously described [2330 of 1953 (Benedict & Shockley)], measurements were made of the permittivity and conductivity of p-type Ge in order to determine the effective mass of the holes and the relaxation time. Results are shown graphically and discussed.

537.311.33 : 546.289 **1088**

The Conductivity of Germanium at $2{\cdot}4 \times 10^{10}$ c/s.—Y. Klinger. (*Phys. Rev.*, 15th Oct. 1953, Vol. 92, No. 2, pp. 509–510.) The conductivity of a highly purified Ge sample over the temperature range 0–100°C was determined from the results of permittivity and loss-tangent measurements. At 100°C the h.f. conductivity is approximately half the d.c. conductivity; the h.f. and d.c. activation energies are 0·60 and $0{\cdot}77_5$ eV respectively.

537.311.33 : 546.289 **1089**

Electrical Properties of Gold-Germanium Alloys.—W. C. Dunlap, Jr. (*Phys. Rev.*, 1st Sept. 1953, Vol. 91, No. 5, p. 1282.) Au acts as an acceptor capable of taking up electrons at two distinct energy levels, the first 0·15 eV above the filled band, the second 0·2 eV below the conduction band. At 77°K resistivities up to $5 \times 10^7 \Omega$. cm have been obtained.

537.311.33 : 546.289 **1090**

The Atomic Heat of Germanium below 4°K.—P. H. Keesom & N. Pearlman. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1347–1353.)

537.311.33 : 546.289 : 537.323 **1091**

Measurement of the Thermoelectric Power of Germanium at Temperatures above 78°K.—A. E. Middleton & W. W. Scanlon. (*Phys. Rev.*, 15th Oct. 1953, Vol. 92, No. 2, pp. 219–226.) An experimental investigation on pure and impure Ge over the temperature range 78°–925°K. At low temperatures, where conduction is due to impurity-introduced carriers, the sign of the thermoelectric power is the same as that of the Hall coefficient, the magnitudes of the thermoelectric power, resistivity and Hall coefficient increase with a decrease in the impurity content. With rising temperature the magnitude of the thermoelectric power increases and passes through a maximum, the value for *p*-type material subsequently passing through zero. The results are presented graphically.

537.311.33 : 546.289 : 537.323 **1092**

Theory of Thermoelectric Power in Semiconductors with Applications to Germanium.—V. A. Johnson & K. Lark-Horovitz. (*Phys. Rev.*, 15th Oct. 1953, Vol. 92, No. 2, pp. 226–232.) An expression for the thermoelectric power is obtained in terms of the Fermi level, width of forbidden band, temperature, ratio of electron to hole mobility, and effective electron and hole masses. For the impurity range, the formula can be simplified to involve only the Hall coefficient and the temperature. Consideration is given to the case when charge carriage by both holes and electrons must be taken into account. The results are compared with those obtained experimentally by Middleton & Scanlon (1091 above).

537.311.33 : 546.289 : 537.323 **1093**

Thermoelectric Power of Germanium below Room Temperature.—H. P. R. Frederikse. (*Phys. Rev.*, 15th Oct. 1953, Vol. 92, No. 2, pp. 248–252.) Measurements were made on *n*-type Ge samples in the range 10°–300°K. The temperature dependence at temperatures above 200°K is in good agreement with conventional theory but below this temperature the thermoelectric power rises sharply above the predicted value and reaches a maximum of several millivolts per degree (with Cu) at 15°K. This deviation is due to the disturbance of the phonon equilibrium.

537.311.33 : 546.289 : 539.3 **1094**

Germanium under Ultrasonic Stress: Part 1 — Anelastic Effects.—G. S. Baker, L. M. Slifkin & J. W. Marx. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, p. 1331.) Five samples of 30-Ω. cm single crystals, in the form of right prisms with the major axis along the [100] direction, were driven in fundamental longitudinal vibration at 111 kc/s. Young's modulus E_{100} was measured at temperatures between 26° and 876°C. Anomalies were observed in two samples.

537.311.33 : 546.289 : 539.3 **1095**

Germanium under Ultrasonic Stress: Part 2 — Dynamic Yield Point.—G. S. Baker, L. M. Slifkin & J. W. Marx. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1331–1332.) The transient and the residual effects on the yield stress were investigated at temperatures up to 614°C for mechanically normal Ge specimens of conductivity $\sim 20\Omega$. cm, cut with the major axis parallel to the [111] direction, and driven in fundamental longitudinal vibration at ~ 37 kc/s.

537.311.33 : 546.472.21 **1096**

Some Electrical and Optical Properties of Synthetic Single Crystals of Zinc Sulfide.—W. W. Piper. (*Phys. Rev.*, 1st Oct. 1953, Vol. 92, No. 1, pp. 23–27.) A report of measurements on hexagonal ZnS (wurtzite) to determine the energy band gap.

537.311.33 : 546.472.21 **1097**

Perfect Crystals of Zinc Sulfide.—W. W. Piper & W. L. Roth. (*Phys. Rev.*, 15th Oct. 1953, Vol. 92, No. 2, p. 503.) Differences between the properties of ZnS crystals grown by sublimation in an atmosphere of hydrogen and those of ordinary ZnS crystals are discussed.

537.311.33 : 546.682.86 **1098**

Optical Properties of Indium Antimonide.—M. Tanenbaum & H. B. Briggs. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1561–1562.) Measurements indicate that the intrinsic limit of absorption lies at 7 μ, and that the presence of Ni as an impurity is at least partly responsible for anomalous transmission in the range 3–7 μ.

537.311.33 : 546.86.48 **1099**

Impurity and Intrinsic Semiconduction of Intermetallic Compounds: Part 2.—E. Justi & G. Lautz. (*Z. Naturf.*, Sept. 1952, Vol. 7a, No. 9, pp. 602–613.) An experimental investigation is made of the temperature dependence of the electrical conductivity, the variation of resistivity in a magnetic field, the differential thermoelectric power and the rectifying properties of CdSb. The results show that, as predicted by the theory presented in part 1 (3619 of 1953), CdSb is an intrinsic semiconductor in the stoichiometric state, and can be turned into an impurity semiconductor by departure from stoichiometric composition or by adding other metals.

537.311.33 : 621.396.822 **1100**

A Possible Mechanism for 1/*f* Noise Generation in Semiconductor Filaments.—L. Bess. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, p. 1569.) Analysis is presented based on the Brownian motion of a surface atom displaced from its equilibrium position.

538.221 **1101**

Orientational Superstructures.—L. Néel. (*C. R. Acad. Sci., Paris*, 21st Dec. 1953, Vol. 237, No. 25, pp. 1613–1616.) Discussion of phenomena induced in solid solutions of ferromagnetic materials with crystals of cubic structure, when cooled so as to retain permanent anisotropy. Magnetic anisotropy of various ferromagnetic alloys is attributed to this phenomenon.

538.221 **1102**

Definition of a Ferromagnetic State with Maximum Stability.—J. Creusot & A. Langevin. (*C. R. Acad. Sci., Paris*, 9th Dec. 1953, Vol. 237, No. 23, pp. 1499–1500.) B/H measurements were made on various materials with the object of finding the most stable equilibrium state corresponding to each value of H, so that B is a two-valued function of H. Superposed on the magnetizing field H is an alternating field whose strength is varied continuously down to zero; B is then measured. The formula obtained for B as a function of H is in agreement with that proposed by P. Langevin in 1911.

538.221 **1103**

Surface Anisotropy of Ferromagnetic Substances.—L. Néel. (*C. R. Acad. Sci., Paris*, 9th Dec. 1953, Vol. 237, No. 23, pp. 1468–1470.)

538.221 **1104**

Study of the Ferromagnetism of Multicrystal and Single-Crystal Cementite [Fe_3C].—P. Blum & R. Pauthenet. (*C. R. Acad. Sci., Paris*, 9th Dec. 1953, Vol. 237, No. 23, pp. 1501–1502.) Measurements over the temperature range 20·4°–500°K are reported.

538.221 **1105**

Theory of Saturation Magnetization in Binary Ferromagnetic Alloys.—H. Statz. (*Z. Naturf.*, Aug. 1952, Vol. 7a, No. 8, pp. 506–511.) The electron structure of the alloys Ni-Cu, Ni-Zn, Ni-Co, Fe-Ni, Fe-Co, Fe-V and Fe-Cr is investigated in relation to the saturation magnetization.

538.221 **1106**

Variation of the Magnetic Permeability of a Mild Steel subjected to a Periodic Stress.—G. Vidal & P. Lanusse. (*C. R. Acad. Sci., Paris*, 16th Nov. 1953, Vol. 237, No. 20, pp. 1213–1215.) Continuation of work noted previously (446 of February).

538.221 : 621.318.124 **1107**

Dielectric Behaviour of Granular Semiconducting Aggregates, with Special Reference to some Magnesium Ferrites.—A. Fairweather & E. J. Frost. (*Proc. Instn elect. Engrs*, Part IIA, 1953, Vol. 100, No. 3, pp. 15–22.) "Aggregated granular semiconductors can display high permittivities and dispersion effects which vary with temperature and voltage. This behaviour need not be characteristic of the granule material: it can be a consequence of its conductivity and of a particular kind of inhomogeneity of the aggregate arising from the contact structure of the intergranular boundaries. The dielectric properties of certain sintered magnesium ferrites can be accounted for in this way."

538.221 : 621.318.124 : 538.66 **1108**

On the Magnetization of Magnesium Ferrite.—N. Sakamoto, T. Asahi & S. Miyahara. (*J. phys. Soc. Japan*, Sept.–Oct. 1953, Vol. 8, No. 5, pp. 677–678.) An experimental investigation of the effect of heat treatment is reported. The results are summarized in a table showing the rates of cooling from 1100°C and the saturation magnetization per mol at room temperature. A table is also given of the characteristic temperatures, derived from Néel's chemical-equilibrium condition (3159 of 1949), corresponding to the various quenching temperatures.

538.221 : 621.318.134 **1109**

Influence of the Ionic Diameters of the Rare Earths on the Ferromagnetic Properties of their Ferrites.—G. Guiot-Guillain. (*C. R. Acad. Sci., Paris*, 21st Dec. 1953, Vol. 237, No. 25, pp. 1654–1656.) The ferromagnetic Curie points for three groups of rare-earth ferrites exhibiting distinct properties are shown to be related to the ionic diameters by simple expressions. An explanation is advanced of the observations of two Curie points in one group.

538.23 **1110**

Some New Relations connecting the Magnitudes of Losses with the Coercive Force.—N. S. Akulov & T. A. Elkina. (*C. R. Acad. Sci. U.R.S.S.*, 21st March 1952, Vol. 83, No. 3, pp. 377–379. In Russian.) The irreversible magnetization (retentivity) and the losses in weak fields can be calculated by assuming ferromagnetic materials to consist of elementary regions with rectangular hysteresis loops [Preisach (3691 of 1935)], the coercive force varying from region to region. The experimental and calculated losses for several materials are in good agreement.

538.632 : [546.817.241 + 546.331.31 **1111**

Sensitive Hall Measurements on NaCl and on Photoconductive PbTe.—J. L. Levy. (*Phys. Rev.*, 15th Oct. 1953, Vol. 92, No. 2, pp. 215–218.) Measurements were made on NaCl over the temperature range 650–795°C and on PbTe at 190°C and at 30°C. Because of the high noise level, only an upper limit for the Hall mobility could be determined for NaCl. The results for PbTe support Simpson's theory (861 of 1952) that an increase in photoconductivity is primarily due to an increase in carrier density and only secondarily to a change of mobility.

539.153 : 546.281.26 **1112**

Energy of Trapped Electrons in Ionic Solids.—K. Lehovec. (*Phys. Rev.*, 15th Oct. 1953, Vol. 92, No. 2, pp. 253–258.) The energy of an electron localized in a crystal at an impurity carrying multiple positive charges is calculated. The results are applied to a tentative interpretation of activation energies of SiC crystals observed by Busch (745 of 1947).

546.26 : 539.215.3 : 537.311.4 **1113**

The Properties of Carbon Contacts.—R. O. Grisdale. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1288–1296.) The correlation between the contact properties and the crystallographic structure of the surfaces is relatively little influenced by the intercrystal boundaries. The contact properties are determined by those of the small number of crystals in contact. The physical properties of these crystals are studied.

546.431-31 **1114**

Oxygen Vacancies in Barium Oxide.—R. L. Sproull, R. S. Bever & G. Libowitz. (*Phys. Rev.*, 1st Oct. 1953, Vol. 92, No. 1, pp. 77–80.) The diffusion of the blue coloration produced when BaO crystals are heated in certain metal vapours (1115 below) was measured at temperatures between 800° and 1300°C. Comparison of the results with those obtained by Redington (432 of 1953) indicates that the diffusion process associated with the coloration does not involve the transport of Ba, and that the principal lattice defects in BaO with excess metal are O vacancies.

546.431-31 : [535.215 + 535.343.2 **1115**

Optical Absorption and Photoconduction in the Visible and Near Infrared in Single Crystals of BaO.—W. C. Dash. (*Phys. Rev.*, 1st Oct. 1953, Vol. 92, No. 1, pp. 68–76.) Optical-absorption measurements indicate the presence of absorption bands at 0·8 and 1·4 eV, induced by ultraviolet or X-ray irradiation at about − 160°C. These bands are enhanced about fivefold on heating a crystal in air to about 1600°C and quenching. Absorption curves for crystals heated in Ba, Al, Mg or Ca vapour all exhibit a maximum at 2 eV, which is attributed to interstitial Ba or O vacancies. Photoconduction studies indicate the presence of energy levels at 2 and 2·6 eV as well as those at 0·8 and 1·4 eV.

546.431.824-31 **1116**

Temperature Changes of Single Crystals of $BaTiO_3$.—I. N. Belyaev, N. S. Novosil'tsev, E. G. Fesenko & A. L. Khodakov. (*C. R. Acad. Sci. U.R.S.S.*, 11th April 1952, Vol. 83, No. 5, pp. 675–676. In Russian.) The temperature dependence of the dielectric constant and of the crystal cell parameters was determined for two crystals prepared from a solution and one by double decomposition. The results are shown graphically.

546.431.824-31 : 537.226.33 **1117**

Time Effects in the Hysteresis Loop of Polycrystalline Barium Titanate.—M. McQuarrie. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1334–1335.) The maximum and the remanent polarization decrease with aging by approximately the same amount until the loop shows a constriction at the centre. This effect can be partially annulled by application of a strong alternating field, and completely annulled by heating to above the Curie temperature.

621.383.49 : 546.482.21 : 535.215.5 **1118**

Photoresistivity and Photoactivation of CdS Single Crystals.—V. E. Lashkarev, V. S. Medvedev, A. I. Skopenko, G. A. Fedorus & M. K. Sheinkman. (*C. R. Acad. Sci. U.R.S.S.*, 11th Oct. 1952, Vol. 86, No. 5, pp. 905–907. In Russian.) The increase of light sensitivity due to background illumination was investigated. Graphs are shown of the variation in sensitivity (photoelectric-current/quantum) with the wavelengths of the background illumination λ_p and impulse illumination λ_i, in the visible-light range. The spectral sensitivity in the 2 100–4 000-Å range is also shown.

546.561.221 **1119**

On the Electrical Conductivity of Cuprous Sulfide: a Diffusion Theory.—I. Yokota. (*J. phys. Soc. Japan*, Sept./Oct. 1953, Vol. 8, No. 5, pp. 595–602.) Cuprous sulphide, a p-type semiconductor, exhibits mixed electronic and ionic conduction in the 110–470°C β phase. A theory of conduction is developed which gives values for the potential distribution in the material in good agreement with values observed by Miyatani & Suzuki (1120 below), for both transient and steady-state conditions. The temperature dependence of the ionic and hole conductivities and of the mobility of vacant copper ion lattice points is shown graphically.

546.561.221 **1120**

On the Electric Conductivity of Cuprous Sulfide: Experiment.—S. Miyatani & Y. Suzuki. (*J. phys. Soc. Japan*, Sept./Oct. 1953, Vol. 8, No. 5, pp. 680–681.) Yokota's theory of conduction (1119 above) is used to calculate the mobility and the concentration of lattice defects from the experimental results for β-phase cuprous sulphide.

546.817.831.4.03 + 546.817.824.03 **1121**

Ferroelectricity versus Antiferroelectricity in the Solid Solutions of $PbZrO_3$ and $PbTiO_3$.—E. Sawaguchi. (*J. phys. Soc. Japan*, Sept./Oct. 1953, Vol. 8, No. 5, pp. 615–629.) The phase diagram of the solid solutions was investigated by measuring the variations with temperature of the dielectric constant, thermal expansion, specific heat and lattice constants. In $Pb(Zr97\text{-}Ti3)O_3$, two antiferroelectric phases, one ferroelectric phase and one paraelectric phase were observed. The free energies in the four states are compared as functions of the temperature and the Ti ion concentration. The results are shown graphically.

548.0 : 539.378.3 **1122**

Some Predicted Effects of Temperature Gradients on Diffusion in Crystals.—W. Shockley. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1563–1564.) Experiments are outlined by means of which it is possible to distinguish between diffusion due to interstitial atoms and diffusion due to vacancies.

621.315.61 : 061.3 **1123**

Symposium of Papers on Insulating Materials.—(*Proc. Instn elect. Engrs*, Part IIA, 1953, Vol. 100, No. 3, pp. 1–308.) Full report of the proceedings at the symposium held in March 1953, with index.

MATHEMATICS

517.9 **1124**

The Eigenvalues of $\nabla^2 u + \lambda u = 0$ when the Boundary Conditions are given on Semi-infinite Domains.—D. S. Jones. (*Proc. Camb. phil. Soc.*, Oct. 1953, Vol. 49, Part 4, pp. 668–684.) Investigation of an equation which represents the small oscillations of many physical systems.

MEASUREMENTS AND TEST GEAR

621.317 : 537.71 (083.74) **1125**

The Accuracy of Measurement of Electrical Standards.—A. Felton. (*Proc. Instn elect. Engrs*, Part II, Oct. 1953, Vol. 100, No. 77, pp. 543–544.) Discussion on 1952 of 1952.

621.317 : 621.383.2 **1126**

The Photodianode.—Deloffre, Pierre & Roig. (See 1249.)

621.317.3 : 621.396.67.029.64 **1127**

Measurements on Aerials for Centimetre Waves.—M. Bouix. (*Ann. Télécommun.*, Oct. 1953, Vol. 8, No. 10, pp. 314–326.) Methods are discussed for the measurement of (*a*) s.w.r. (to test the matching between aerial and feeder), (*b*) phase of primary radiators, (*c*) radiation patterns both for primary radiators and complete aerial systems, (*d*) gain. Equipment described includes transmitter and sensitive receiver for the radiation-pattern and gain measurements. Attention is drawn to special requirements as regards the terrain over which the tests are made.

621.317.3.029.63/.64 + 534.62 **1128**

A New Anechoic Chamber for Sound Waves and Short Electromagnetic Waves.—Meyer, Kurtze, Severin & Tamm. (See 942.)

621.317.31 : 621.375.2 **1129**

Measurement of Weak Electric Charges by means of Pulse Technique — Study of a Fast-Acting Preamplifier with High Input Impedance and Low Noise.—H. Guillon. (*Onde élect.*, Nov. 1953, Vol. 33, No. 320, pp. 627–636.)

621.317.31 : 621.387.4 **1130**

Measurement of Weak Electric Charges by means of Pulse Technique — α-Radiation Spectrometry.—G. Valladas. (*Onde élect.*, Nov. 1953, Vol. 33, No. 320, pp. 615–626.)

621.317.32 : 537.1 **1131**

The Static and Dynamic Measurement of Electromotive Forces.—W. J. Poppelbaum. (*Helv. phys. Acta*, 15th Sept. 1953, Vol. 26, No. 5, pp. 489–498. In French.) Generalization of Meixner's equation (*Ann. Phys., Lpz.*, 1939, Vol. 35, p. 701) leads to a formulation including within its scope phenomena as varied as induction, thermoelectricity and the chemical processes in a cell. Consideration of the distinction between voltaic and galvanic potential difference results in a simple method of taking account of contact potential difference in static measurements.

621.317.335 **1132**

Precise Measurement of the Complex Dielectric Constants of Liquids by Voltage Resonance.—C. Abgrall. (*C. R. Acad. Sci., Paris*, 21st Dec. 1953, Vol. 237, No. 25, pp. 1650–1652.) A substitution method is used in which either a standard capacitor or the cell containing the liquid is connected in an oscillatory circuit in series with a high impedance. Analysis of the system is based on a linear formulation, and the effect of the impedances of the connections is examined.

621.317.335.029.64 **1133**

Method for the Measurement of the Dielectric Constant of Gases at Ultrahigh Frequencies.—A. Gozzini & E. Polacco. (*C. R. Acad. Sci., Paris*, 9th Dec. 1953, Vol. 237, No. 23, pp. 1497–1499.) A klystron generator, operated at about 10 kMc/s, is frequency modulated between the limiting frequencies ν_0 and ν_1 by application of a sawtooth voltage to the repeller. Two cavities tuned to different frequencies between ν_0 and ν_1 are associated with the system, one of the cavities being filled with the gas under test. The dielectric constant is determined from the time interval between the instants when the two cavities resonate.

621.317.335.029.64 **1134**

Complementary Note on the Method of Measurement of the Dielectric Constant of Gases at U.H.F.—A. Gozzini & E. Polacco. (*C. R. Acad. Sci., Paris*, 21st Dec. 1953, Vol. 237, No. 25, pp. 1652–1654.) A modification of the method previously described (1133 above) to give improved sensitivity is proposed.

621.317.335.3.029.65 **1135**

A Spectrometer for Millimetre Wavelengths.—W. Culshaw. (*Proc. Instn elect. Engrs*, Part IIA, 1953, Vol. 100, No. 3, pp. 5–14. Discussion, pp. 54–60.) A free-space method is described for the measurement of permittivity at mm λ, using the microwave analogue of the optical spectrometer, horns with lenses taking the place of the optical collimator and telescope. The reflectivity of sheets of material is investigated at different angles of incidence for different polarizations; interference minima and Brewster angle are determined and accurate values of permittivity are hence deduced. The effects of dielectric loss and of diffraction are discussed. Results substantiating the theory are presented. An extension of the method to deal with liquids is described.

621.317.34.018.75 : 621.315.212 **1136**

Echo Meter with Very Short Pulse Duration for Investigation of Coaxial-Pair Television Cables.—G. Comte, M. Bouderlique & G. Thévenet. (*Câbles & Transm.*, July 1953, Vol. 7, No. 3, pp. 263–269.) A description is given, with circuit details, of an instrument designed for production testing of television cables, with application for research at higher frequencies. Features of the equipment are the short pulse duration (0·02 μs) and the use of distributed amplification in the echo amplifier to give a wide frequency band.

621.317.34.029.5/.6 : 621.315.212 **1137**

Tests at Very High Frequencies on Production Lengths of Coaxial Cable.—J. Lorrin. (*Câbles & Transm.*, July 1953, Vol. 7, No. 3, pp. 218–241.) A null method of measurement is described for determination of propagation coefficient and characteristic impedance in production testing of coaxial cables. Measurement principles are based on transmission-line theory taking account of irregularities; this is dealt with in an appendix. Bridge balance is obtained by adjustment of both reactance and frequency, and the design of an oscillator/receiver unit with a single frequency control is discussed. Illustrated descriptions are given of two instruments. Results of measurements on cables of length 100–300 m are shown.

621.317.341.029.62/.65 **1138**

A.M. System measures Microwave Attenuation.—J. Korewick. (*Electronics*, Jan. 1954, Vol. 27, No. 1, pp. 175–177.) See 803 of March.

621.317.35 : 621.3.018.78 **1139**

Measuring Non-linearity.—D. C. Pressey. (*Wireless World*, Feb. 1954, Vol. 60, No. 2, pp. 60–62.) A simple method is presented which is supplementary to that described by Wigan (2383 of 1953) and which uses a frequency-insensitive element to perform the subtraction of the fundamental from the composite wave.

621.317.38.029.63 **1140**

Force on a Shorted Ring in a U.H.F. Field in a Coaxial Cavity.—S. N. Kalra. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1339–1340.) The change in potential energy of a metal ring, the dimensions of which are small compared with λ, is made the basis of power measurement. Accuracy for powers of a few watts is within $\sim 1\%$.

621.317.44 **1141**

Dynamic Measurements on Electromagnetic Devices.—M. A. Logan. (*Bell Syst. tech. J.*, Nov. 1953, Vol. 32, No. 6, pp. 1413–1467.) An electronic timing system controlling mercury-contact relays is used to switch in the measuring instrument (e.g., fluxmeter) for a very short period only at a preselected instant of each cycle of operation of the device tested. The system and the circuits required for the dynamic measurement of magnetic flux, current, displacement and velocity response are described.

621.317.444 **1142**

A Small Sensitive Magnetometer.—T. M. Palmer. (*Proc. Instn elect. Engrs*, Part II, Oct. 1953, Vol. 100, No. 77, pp. 545–550.) The measuring head contains a solenoid through which is passed a d.c. balancing out the field under test. A saturating current of frequency 5 kc/s is passed through a fine mumetal wire within the solenoid, causing its effective longitudinal permeability to alternate, so that a field along the wire produces an alternating e.m.f. in the solenoid; this e.m.f. serves as an indication of the field. A change of 2×10^{-5} oersted can be detected. The measurement range is limited to about 50 oersted due to the heating of the solenoid.

621.317.7 **1143**

Device for Measurement of the Time Constants of Indicating Instruments.—J. Mey & H. Thibert. (*Ann. Télécommun.*, Oct. 1953, Vol. 8, No. 10, pp. 327–334.) The time constant for indication, the time for restoration to zero, and the 'integrating' time are considered, particularly in relation to volume and modulation meters for telephone testing. Apparatus devised for measuring these time constants comprises an electro-optical system for marking the passage of a galvanometer needle through a predetermined position, an electronic chronometer, and a 'chronotome' relay.

621.317.7.088 **1144**

Performance Limits in Electrical Instruments.—A. H. M. Arnold. (*Proc. Instn elect. Engrs*, Part II, Oct. 1953, Vol. 100, No. 77, pp. 543–544.) Discussion on 1971 of 1952.

621.317.714.024 **1145**

Non-Contact D.C. Ammeter.—W. H. Bailey. (*Elect. Rev., Lond.*, 21st Aug. 1953, Vol. 153, No. 8, pp. 397–400.) Description of a device which permits remote indication and recording of the current in a cable.

621.317.729 **1146**

The Accurate Mapping of Electric Fields in an Electrolytic Tank.—K. F. Sander & J. G. Yates. (*Proc. Instn elect. Engrs*, Part II, Oct. 1953, Vol. 100, No. 77, pp. 569–570.) Discussion on 2739 of 1953.

621.317.756 + 621.317.77 **1147**

A Harmonic-Response-Testing Equipment for Linear Systems.—D. O. Burns & C. W. Cooper. (*Proc. Instn elect. Engrs*, Part II, Oct. 1953, Vol. 100, No. 77, p. 467.) Discussion on 3374 of 1953.

621.317.76 + 531.771] : 621.387 **1148**

A High-Speed Precision Tachometer.—Bland & Cooper. (See 1153.)

621.373.43 : 621.317.3 **1149**

High-Voltage Sawtooth and Rectangular-Wave Pulse Generator.—W. D. Edwards. (*Electronic Engng*, Jan. 1954, Vol. 26, No. 311, pp. 36–39.) Descriptions are given of a square-wave generator giving an output of 0–20 kV with pulse duration continuously variable between 0·05 and 80 μs, and of a sawtooth generator giving a peak output of 18 kV with rise time of 15 μs–10 ms. The generators are specially designed for measurements of dielectric strength.

621.397.5 : 535.623].001.4 **1150**

Methods of Verifying Adherence to the N.T.S.C. Color Signal Specifications.—A. C. Luther, Jr. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 235–240.) The composition of the colour signal is determined by measuring the amplitudes and relative phases of a group of bar signals corresponding to saturated primary colours and their complements. The use of a simple demodulator for accurate measurement of phase at the 3·58-Mc/s subcarrier frequency is described.

621.397.5 : 535.623].001.4 **1151**

A Versatile Approach to the Measurement of Amplitude Distortion in Color Television.—J. A. Bauer. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 240–246.) The importance of system linearity for maintaining the selected value of gamma is emphasized, and an instrument developed for checking the degree of nonlinearity is described.

621.397.5 : 535.623].001.4 **1152**

Test Instruments for Color Television.—W. C. Morrison, K. Karstad & W. L. Behrend. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 247–258.) Equipment for use in measuring frequency response, differential gain and differential phase, and sound-to-picture frequency separation is described.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

531.771 + 621.317.76] : 621.387 **1153**

A High-Speed Precision Tachometer.—W. R. Bland & B. J. Cooper. (*Electronic Engng*, Jan. 1954, Vol. 26, No. 311, pp. 2–8.) An integrating-type electronic tachometer with ranges of 0–8 000 and 10–80 000 r.p.m. and a reading accuracy within 0·01% uses cold-cathode glow-discharge tubes to give a visual display. The instrument can be used with a variety of pickups, and can also be used as a frequency meter.

551.508.1 : 621.396.91 **1154**

The Ground Equipment for the F-Type Radiosonde.—B. B. Huddar, K. Nagarajan, N. C. Dhar & S. P. Venkiteshwaran. (*Indian J. Met. Geophys.*, Oct. 1953, Vol. 4, No. 4, pp. 347–352.) Equipment in use at Poona is described; the receiver is of superregenerative type, and the recorder is of moving-coil type.

621-52 : 621.389 **1155**

An Electronic Process Controller.—J. R. Boundy & S. A. Bergen. (*Proc. Instn elect. Engrs*, Part II, Oct. 1953, Vol. 100, No. 77, pp. 561–562.) Discussion on 1386 of 1952.

621.316.722 : 621.383.27 : 621.387.464 **1156**

Device for the Stabilization of Photomultipliers.—R. Ascoli. (*Nuovo Cim.*, 1st July 1952, Vol. 9, No. 7, pp. 615–617.) A stabilizer for scintillation counters makes use of the constancy of the emission from a radioactive source.

621.385.832/.833] : 538.691 **1157**

Image Distortion due to Pole-Piece Asymmetry in Electron Lenses.—W. Glaser & P. Schiske. (*Z. angew. Phys.*, Sept. 1953, Vol. 5, No. 9, pp. 329–339.)

621.385.833 **1158**

Electron-Optical Properties of Electrostatic Lenses: Part 2.—W. Lippert & W. Pohlit. (*Optik, Stuttgart*, 1953, Vol. 10, No. 9, pp. 447–454.) Further results are given of the work on unipotential lenses previously noted (795 of 1953).

621.385.833 **1159**

Trajectories in the Symmetrical Electron Lens.—L. Jacob & J. R. Shah. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1261–1266.) Numerical evaluation of trajectories in a strong unipotential lens. See also 1396 of 1952 (Shah & Jacob).

621.387.464 **1160**

The Efficiency of the Anthracene Scintillation Coun.ter—D. K. Butt. (*Proc. phys. Soc.*, 1st Oct. 1953, Vol. 66, No. 406A, pp. 940–944.) Investigation of a counter having a crystal about 1 cm² × 2 mm placed on the end of an uncooled E.M.I. Type-5060 photomultiplier tube.

621.387.464 : 550.835 **1161**

A Scintillation Counter for Radioactivity Prospecting.—D. H. Peirson & J. Pickup. (*J. Brit. Instn Radio Engrs*, Jan. 1954, Vol. 14, No. 1, pp. 25–32.) A simple and compact arrangement is obtained by using a scintillation counter in conjunction with a cold-cathode valve in the counting-rate meter circuit and a specially designed recording microammeter.

PROPAGATION OF WAVES

538.566 + 621.372.2 **1162**

The Effect of the Radiation Condition in the case of Complex Wave Number, and its Significance in the Problem of Surface Waves.—A. Haug. (*Z. Naturf.*, Aug. 1952, Vol. 7a, No. 8, pp. 501–505.) It is shown that Sommerfeld's radiation condition (i.e., that the wave vanishes at infinity) guarantees the uniqueness of the solutions of the wave equation $\Delta u + k^2 u = 0$ in the whole space, not only for real but also for complex values of the wave number k. It follows from the treatment presented that the existence of Sommerfeld's surface wave is not inconsistent with the radiation condition.

538.566 + 621.372.2] : 621.3.012 **1163**

New Chart for the Solution of Transmission-Line and Polarization Problems.—Deschamps. (See 965.)

621.396.11 **1164**

Nonstandard Radio Propagation.—P. G. Forsyth. (*Nature, Lond.*, 21st Nov. 1953, Vol. 172, No. 4386, p. 966.) Brief report of long-range reception observed at Ottawa on frequencies between 60 and 72 Mc/s.

621.396.11 : 551.5 **1165**

Ultra-short-Wave Field Strength in a Ground-Based Radio Duct.—R. S. Unwin. (*Nature, Lond.*, 7th Nov. 1953, Vol. 172, No. 4384, pp. 856–857.) Discussion of field-strength observations at λ 3 cm, 9 cm, and 60 cm, made at various heights over the sea under widely differing superrefractive conditions. A rough estimate can be made of the maximum field strength in the duct at

distances up to 100 km from the transmitter, if the average width of the ground-based duct can be assumed from meteorological data to be greater than a critical value for the particular wavelength. See also 1471 of 1953 (Hay & Unwin) and back references.

621.396.11 : 551.510.535 **1166**

Coupling and Conditions for Reflection of the Ordinary and Extraordinary Electromagnetic Waves in an Inhomogeneous Anisotropic Plasma (Ionosphere).—R. Jancel & T. Kahan. (*C. R. Acad. Sci., Paris*, 21st Dec. 1953, Vol. 237, No. 25, pp. 1657–1659.) The propagation equations are solved, taking the plasma as characterized by a dielectric tensor which does not vary with height except in so far as the electron concentration varies, and taking account of the earth's magnetic field. The conditions giving rise to triple splitting are established.

621.396.11 : 551.510.535 **1167**

A New Phenomenon of Interaction between Waves and Free Electrons subjected to the Terrestrial Magnetic Field.—M. Cutolo. (*Nuovo Cim.*, 1st Aug. 1952, Vol. 9, No. 8, pp. 687–698.) Experiments indicate that modulated waves of carrier frequency equal to the frequency of rotation of free electrons suffer appreciable demodulation in traversing the ionosphere, due to the action of the terrestrial magnetic field. The magnitude of the effect increases with the modulation frequency. Various names, e.g., self-demodulation, are suggested for the effect. The physical process involved is discussed and the importance of the effect in broadcasting and in the study of the ionosphere E layer is indicated. A long summary in English is included. See also 1758 of 1951.

621.396.11 : 621.317.353.3 : 551.510.535 **1168**

Experimental Determination of the Resonance Curves in the Motion of the Slow Electrons in the Upper Atmosphere.—M. Cutolo. (*Nuovo Cim.*, 1st May 1952, Vol. 9, No. 5, pp. 391–407.) Theory of gyrointeraction between waves in an ionized medium is reviewed. Double-hump or single-hump resonance curves are obtained, depending on the experimental conditions. Experiments made in Italy in 1950 are described, when by varying the frequency of the unmodulated wave the transition from the double-hump to the single-hump curve was observed. See also 720 of March.

621.396.812 : 621.396.621.59 **1169**

Long-Range Communication Trends.—Crosby. (See 1172.)

RECEPTION

621.396.62/.63 **1170**

Conelrad Receiver with Built-In Alarm.—R. E. Quenstedt. (*Electronics*, Jan. 1954, Vol. 27, No. 1, pp. 156–157.) Description of a f.m. broadcast receiver with carrier-failure alarm, for use in controlled broadcast stations required to monitor a regional parent station of a civil defence scheme.

621.396.621 + 621.397.621 **1171**

Radio and Television at the 16th Salon National.—P. A. François. (*TSF et TV*, Nov. & Dec. 1953, Vol. 29, Nos. 301 & 302, pp. 359–364 & 393–394.) General report of the Paris exhibition, 25th Sept.–5th Oct. 1953, with tabulated details of the television receivers shown. Reports of the exhibition are also given in *Toute la Radio*, Nov. 1953, Vol. 20, No. 180, pp. 410–413, and *Télévision*, Nov. 1953, No. 38, pp. 264–266.

621.396.621.59 : 621.396.812 **1172**

Long-Range Communication Trends.—M. G. Crosby. (*Trans. Inst. Radio Engrs*, July 1953, Vol. CS-1, No. 1, pp. 41–53.) Various types of fading due to multipath ionospheric transmission are reviewed and methods of reducing fading effects are discussed. The interference rejection and i.f./a.f. selectivity transfer obtained with exalted-carrier detection are noted. The advantage of frequency-shift keying for telegraphy is pointed out. The application of exalted-carrier and s.s.b. methods in a triple-diversity system is illustrated.

STATIONS AND COMMUNICATION SYSTEMS

621.376.2 : 621.396.5 : 621.396.822 **1173**

Noise and Radiotelephony with Amplitude Modulation.—P. Marcou. (*Ann. Télécommun.*, Oct. 1953, Vol. 8, No. 10, pp. 339–351.) D.s.b. and s.s.b. a.m. systems are compared, using as criterion the signal/noise ratio at the receiver output when white noise is mixed with the r.f. signal. The effect of different detecting processes on the signal/noise ratio is analysed. The s.s.b. system makes better use of available power inasmuch as (*a*) the carrier is suppressed or reduced, (*b*) the r.f. noise is halved, and (*c*) reception is linear; the advantage due to the this last feature only becomes significant, however, for output signal/noise ratios too low to give good intelligibility even with this improvement. With s.s.b. transmissions, the ear accepts quasi-synchronous demodulation, not necessarily in phase.

621.39.001.11 : 621.376 **1174**

Comparative Study of Modulation Methods.—R. M. Page. (*Trans. Inst. Radio Engrs*, July 1953, Vol. CS-1, No. 1, pp. 13–22.) To express the results of information theory in practical terms, direct, coded and modulated-carrier coded transmission systems are analysed on the basis of Shannon's equation. Basic transformer theory is applied to the action of coding and an expression is derived relating power ratio to bandwidth ratio in terms of the dynamic range of the information. Curves showing signal/noise ratio at a receiver output as a function of signal input power for s.s.b. a.m., d.s.b. a.m., wide-band f.m. and binary-code p.c.m. systems are compared.

621.39.001.11 : [621.394 + 621.396.3 **1175**

The Transmission of Intelligence in Typescript.—I. S. Coggeshall. (*Trans. Inst. Radio Engrs*, July 1953, Vol. CS-1, No. 1, pp. 4–13.) Practical aspects of the application of communication theory in telegraphy are reviewed.

621.396.41 **1176**

Properties of a Multiplex Signal with Pulses of Alternate Sign.—L. Le Blan. (*C. R. Acad. Sci., Paris*, 21st Dec. 1953, Vol. 237, No. 25, pp. 1662–1664.) Analysis of a two-channel system in which one channel uses positive a.m. pulses while the other uses negative a.m. pulses. Simple methods can be used to separate the two signals at the receiver; in general, arrangements must be provided for eliminating crosstalk.

621.396.44 **1177**

Simplified Carrier-Current System for Short Distances.—G. H. Bast & J. L. Hurault. (*Câbles & Transm.*, July 1953, Vol. 7, No. 3, pp. 185–217.) The paper is based on an investigation made for the Netherlands Administration. A detailed study is made of design requirements for a multiplex system operating over distances of 20–300 km on any suitable existing lines. In a discussion of economic aspects, the attenuation required to avoid crosstalk is calculated for different channel widths, and the choice of a 6-kc/s bandwidth is explained. Full descriptions are given of terminal equipment for a 32-channel system on symmetrical-pair cables and the main oscillators and control circuits at the central station.

621.396.662.029.5/.6 **1178**

Design Trends in Communication Equipment.—L. M. Craft. (*Trans. Inst. Radio Engrs*, July 1953, Vol. CS-1, No. 1, pp. 22–30.) General discussion of omnichannel operation of u.s.w. and s.w. equipment. Outline descriptions are given, with illustrations, of automatic tuning and channel-selection units incorporated in Collins transmitters and receivers.

621.396.712 **1179**

La Maison de la Radio, Paris.—H. Testemale. (*Télév. franç.*, Nov. 1953, No. 100, pp. 23–25.) A competition has been held for the design of a building to serve as a comprehensive broadcasting centre; the winning design is described.

621.396.712.029.62 : 621.396.81 **1180**

U.S.W. Planning in Austria.—J. Burgstaller. (*Radio Tech., Vienna*, Oct. 1953, Vol. 29, No. 10, pp. 340–345.) Formulae and curves for the theoretical field strength of horizontally polarized waves received at a height 30 ft above ground, and for the correction factor for the attenuation due to diffraction in mountainous districts are given and discussed. The frequency considered is 98 Mc/s. Maps show the estimated area coverage provided by six 25-kW transmitting stations and, in the case of the Klagenfurt transmitter, the effects of different aerial heights and radiated powers.

621.396.932 **1181**

Aspects of Naval Communications Systems.—J. A. Krcek. (*Trans. Inst. Radio Engrs*, July 1953, Vol. CS-1, No. 1, pp. 54–58.) General review of problems and developments in the design and arrangement of radio equipment aboard a communications vessel which may carry about 150 receivers and 60 transmitters.

621.396.933 **1182**

A Discussion of United Air Lines V.H.F. Network Developments.—K. J. Rhead. (*Trans. Inst. Radio Engrs*, June 1953, No. PGAE-8, pp. 9–11.) The network comprises five transmitter-receiver stations, with automatic locking out of either transmitter or receiver when the other unit is in operation. Preliminary experience indicates that intermodulation effects are considerably reduced by using a stable oscillator, by sub-channelling arrangements, and by restriction of the speech band to the range 200–2 500 c/s.

SUBSIDIARY APPARATUS

621-526 **1183**

Analogue Methods for Optimum Servomechanism Design.—F. C. Fickeisen & T. M. Stout. (*Trans. Amer. Inst. elect. Engrs*, 1952, Vol. 71, Part II, pp. 244–250. Discussion, p. 250.)

621-526 **1184**

Feedback Control Systems with Dead-Time Lag or Distributed Lag by Root-Locus Method.—Y. Chu. (*Trans. Amer. Inst. elect. Engrs*, 1952, Vol. 71, Part II, pp. 291–296.) Generalization and application of the method originated by Evans (2337 of 1952).

621-526 **1185**

Synthesis of Feedback Control System by Phase-Angle Loci.—Y. Chu. (*Trans. Amer. Inst. elect. Engrs*, 1952, Vol. 71, Part II, pp. 330–339.) A modification of Evans' root-locus method (2337 of 1952).

621-526 **1186**

The Use of Nonlinear [tachometric] **Feedback to Improve the Transient Response of a Servomechanism.**—J. B. Lewis. (*Trans. Amer. Inst. elect. Engrs*, 1952, Vol. 71, Part II, pp. 449–453. Discussion, p. 453.)

621-526 : 621.3.016.35 **1187**

Stabilization of a Servomechanism subject to Large Amplitude Oscillation.—E. S. Sherrard. (*Trans. Amer. Inst. elect. Engrs*, 1952, Vol. 71, Part II, pp. 312–324.) The frequency-response method of analysis developed by Kochenburger (224 of 1951) is applied to a system containing a saturable amplifier and in determining the required nonlinear stabilizing filter.

621-526 : 621.3.016.35 **1188**

Stability Limits for Third-Order Servomechanisms.—T. J. Higgins & J. G. Levinthal. (*Trans. Amer. Inst. elect. Engrs*, 1952, Vol. 71, Part II, pp. 459–466. Discussion, pp. 466–467.) Curves are derived giving directly the roots and coefficients of specified cubic characteristic equations. Their use in facilitating analysis and design of servo systems is explained and illustrated.

621-526 : 621.316.7 **1189**

The Analysis of Sampled-Data Systems.—J. R. Ragazzini & L. A. Zadeh. (*Trans. Amer. Inst. elect. Engrs*, 1952, Vol. 71, Part II, pp. 225–232. Discussion, pp. 232–234.) Full paper; summary abstracted in 1801 of 1953.

621.311.6 **1190**

Stable Power Supplies for Microwave Standards.—W. P. Ernst. (*Electronics*, Jan. 1954, Vol. 27, No. 1, pp. 168–171.) A description of the power-supply system for operating the klystron frequency standards at the National Bureau of Standards.

621.314.634.004 **1191**

Selenium Rectifiers — Factors in their Application.—J. Gramels. (*Bell Syst. tech. J.*, Nov. 1953, Vol. 32, No. 6, pp. 1469–1492.)

621.318.5 **1192**

Design of Relays.—(*Bell Syst. tech. J.*, Jan. 1954, Vol. 33, No. 1, pp. 1–259.) A symposium of papers, dealing with design, production, service and measurements.

TELEVISION AND PHOTOTELEGRAPHY

621.397.2 : 535.623 **1193**

The Colorplexer — a Device for Multiplexing Color Television Signals in accordance with the N.T.S.C. Signal Specifications.—E. E. Gloystein & A. H. Turner. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 204–212.) The functions of matrixing, band limiting, delay correction, modulating, burst generating, and mixing are described in detail. Waveforms photographed at several points in the colorplexer are shown for one standard colour-bar signal.

621.397.2 : 535.623 **1194**

Transmission of Color over Inter-City Television Networks.—J. R. Rae. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, No. 1, pp. 270–273.) The additional gain and delay equalizers required for colour transmission and the method for shifting the colour information within the pass band of coaxial cable are discussed.

621.397.24 : 621.315.212.4 **1195**

The Birmingham-Manchester-Holme-Moss Television-Cable System.—R. J. Halsey & H. Williams. (*P.O. elect. Engrs' J.*, Oct. 1953 & Jan. 1954, Vol. 46, Parts 3 & 4, pp. 118–121 & 171–176.) Shortened version of paper noted in 1147 of 1953.

621.397.24 : 621.372.55 **1196**

Adjustment of Bridged-T Phase-Correction Networks used in Television Equipment.—H. Martin. (*Câbles &*

Transm., July 1953, Vol. 7, No. 3, pp. 175–184.) Properties of equalizing networks for television cables are reviewed. A practical method is described, based on measurement of impedance at a frequency for which the phase shift is 180°, by which network impedance can be adjusted to within $\pm 2\Omega$ of the correct value throughout the pass band. Propagation-time/frequency characteristics are shown for two types of network.

621.397.5 **1197**

Fundamental Problems of Subscription Television: the Logical Organization of the Telemeter System.—L. N. Ridenour & G. W. Brown. (*J. Soc. Mot. Pict. Telev. Engrs*, Aug. 1953, Vol. 61, No. 2, pp. 183–194.) The basic principles of a satisfactory 'pay-as-you-view' system are considered. Essential requirements are (*a*) provision of a coin-actuated mechanism controlling a signal decoder, (*b*) programme sales on a variable-price basis, the unit being a single programme rather than a unit of time, (*c*) announcement of details of the available programme on the channel carrying the programme, for the benefit of anyone tuning in to that channel, and (*d*) an accurate record of each show purchased.

621.397.5 **1198**

Camera Adapter for TV Receivers.—L. E. Flory, W. S. Pike & G. W. Gray. (*Electronics*, Jan. 1954, Vol. 27, No. 1, pp. 141–143.) A complete television system for domestic or business use comprises a vidicon camera unit, the picture signals from which are transmitted to the receiver on a v.h.f. carrier via cable; operating voltages for the camera tube are derived from the receiver circuits.

621.397.5 : 535.623 **1199**

Second Color Television Issue.—(*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 1–348.) The whole of this issue is devoted to an account of developments in colour television since 1951. The first group of papers comprises 22 contributions from the National Television System Committee; the titles of these papers, with the page references and the authors' names, are listed below. The second group comprises 27 contributions from individual workers on various branches of the subject; these papers are abstracted separately.

The Future of Color Television (pp. 5–7).—W. R. G. Baker.

Basic Concepts and Evolution of Color Television (pp. 7–9).—E. W. Engstrom.

Psychophysical and Electrical Foundations of Color Television (pp. 9–11).—A. V. Loughren.

The N.T.S.C.—An Exercise in Technical Coordination (pp. 11–14).—D. B. Smith.

N.T.S.C. Signal Specifications (pp. 17–19).

N.T.S.C. Color Television Field Test (pp. 20–43).—R. DeCola, R. E. Shelby & K. McIlwain.

The N.T.S.C. Monographs (pp. 43–45).—D. G. Fink.

The N.T.S.C. Color Television Standards (pp. 46–48).

Colorimetry in Television: Parts 2 & 3 (pp. 48–57).—F. J. Bingley.

The Choice of Axes and Bandwidths for the Chrominance Signals in N.T.S.C. Color Television (pp. 58–59).—G. H. Brown.

The Constant Luminance Principle in N.T.S.C. Color Television (pp. 60–66).—W. F. Bailey.

Mathematical Formulations of the N.T.S.C. Color Television Signal (pp. 66–71).—G. H. Brown.

Transfer Characteristics in N.T.S.C. Color Television (pp. 71–78).—F. J. Bingley.

Choice of Chrominance Subcarrier Frequency in the N.T.S.C. Standards (pp. 79–80).—I. C. Abrahams.

The 'Frequency Interleaving' Principle in the N.T.S.C. Standards (pp. 81–83).—I. C. Abrahams.

Quadrature Cross Talk in N.T.S.C. Color Television (pp. 84–90).—W. F. Bailey & C. J. Hirsch.

Narrow-Band Transmission of the N.T.S.C. Color Signal (pp. 90–91).—J. G. Reddeck.

System Delay Characteristics in N.T.S.C. Color Television (pp. 92–95).—R. C. Palmer.

Effect of Transmitter Characteristics on N.T.S.C. Color Television Signals (pp. 95–105).—G. L. Fredendall & W. C. Morrison.

Color-Carrier Reference Phase Synchronization Accuracy in N.T.S.C. Color Television (pp. 106–133).—D. Richman.

621.397.5 : 535.623 **1200**

The Concept of Transmission Primaries in Color Television.—P. W. Howells. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 134–138.) The concept of colour space is discussed. The location of the three transmission primaries of the N.T.S.C. system (namely, the monochrome signal and the two colour signals) in the C.I.E. colour space is indicated.

621.397.5 : 535.623 **1201**

Colorimetric Analysis of the N.T.S.C. Color Television System.—D. C. Livingston. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 138–150.) Formulae are developed which enable colour fidelity, compatibility, and adherence to the constant-luminance principle to be assessed. Three different forms of the N.T.S.C. system are compared; the superiority of the standard form is indicated. See also *Convention Record Inst. Radio Engrs*, 1953, Part 4, pp. 51–55.

621.397.5 : 535.623 **1202**

Quantitative Spectral Measurements in Color Television.—J. A. Rado & W. L. Hughes. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 151–156.) Measurements of the spectral sensitivities of the pickup devices and of the colorimetric characteristics of the display devices are discussed. Techniques are described using narrow-band optical-interference filters in conjunction with 'red-pass' gelatin filters.

621.397.5 : 535.623 **1203**

Wide-Range Chromaticity Measurements with Photoelectric Colorimeter.—J. B. Chatten. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 156–160.) Detailed description of a tristimulus colorimeter sufficiently accurate for general work in colour television.

621.397.5 : 535.623 **1204**

Reproduction of Colors in Outdoor Scenes.—D. L. MacAdam. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 166–174.) Available spectrophotometric and colorimetric data on the colours of skin, hair, grass, foliage, sky and earth are summarized and measurements of typical colour-film reproductions are presented. Subjective assessments of colour-reproduction quality are discussed on the basis of these data.

621.397.5 : 535.623 **1205**

The Use of Electronic Masking in Color Television.—R. P. Burr. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 192–200.) A discussion of the use of electrical networks for reducing the effects of photographic cross-coupling introduced when using subtractive colour transparencies as material for television transmission.

621.397.5 : 535.623 **1206**

Matrix Networks for Color TV.—W. R. Feingold. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 201–203.) Summation-type circuits required for colour-television transmitters and receivers are described.

621.397.5 : 535.623 **1207**

Transients in Color Television.—P. W. Howells. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 212–220;

Convention Record Inst. Radio Engrs, 1953, Part 4, pp. 24–34.) When a colour transient occurs, the three components of the transmitted signal respond in a manner determined by the characteristics of the individual channels. The system response is characterized by the resulting path along which the reproduced colour point moves through the colour space from its initial to its final location. An analysis is made of such paths, and the corresponding subjective effects are discussed.

621.397.5 : 535.623 **1208**

Transition Effects in Compatible Color Television.—J. B. Chatten. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 221–228.) An experimental video-frequency television system is described for investigating the best choice of the three independent colour-signal components to be transmitted. A description is given of an arrangement for predistorting the luminance signal to compensate for luminance variations arising in the reproduction of colour transients.

621.397.5 : 535.623 **1209**

Reproduction of Luminance Detail by N.T.S.C. Color Television Systems.—D. C. Livingston. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 228–234.) Three different forms of the N.T.S.C. system are compared to determine the relative merits of different methods of gamma correction. The system using a luminance corrector in the transmitter is judged to be the best.

621.397.5 : 535.623 **1210**

Delay Equalization in Color Television.—G. L. Fredendall. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 258–262.) An equalizer designed by the potential-analogue method consists of four conventional all-pass filter sections.

621.397.5 : 535.623 : 778.5 **1211**

Brightness Modification Proposals for Televising Color Film.—W. L. Brewer, J. H. Ladd & J. E. Pinney. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 174–191.) It is recommended that (*a*) the effective luminance range should be modified, either in the film or in the television system, to conform to that available on the kinescope, and (*b*) kinescope reproductions of film colours should be made lighter with increasing saturations. Alternative methods of achieving the colour-dependent brightness compensation are discussed.

621.397.5 : 535.623].001.4 **1212**

Methods of Verifying Adherence to the N.T.S.C. Color Signal Specifications.—Luther. (See 1150.)

621.397.5 : 535.623].001.4 **1213**

A Versatile Approach to the Measurement of Amplitude Distortion in Color Television.—Bauer. (See 1151.)

621.397.5 : 535.623].001.4 **1214**

Test Instruments for Color Television.—Morrison, Karstad & Behrend. (See 1152.)

621.397.61 : 535.623 **1215**

Alignment of a Monochrome TV Transmitter for Broadcasting N.T.S.C. Color Signals.—J. F. Fisher. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 263–270.) A detailed account of the procedure used to adapt the WPTZ (Philadelphia) station.

621.397.611 : 535.623 **1216**

Image Orthicons for Color Cameras.—R. G. Neuhauser, A. A. Rotow & F. S. Veith. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 161–165.) Operating conditions and performance characteristics of the R.C.A. Type-1854 tube are given.

621.397.611.2 **1217**

The Flying-Spot Scanning System by means of the MC 13-16.—J. J. P. Valeton & F. H. J. van der Poel. (*Electronic Applic. Bull.*, June/July 1953, Vol. 14, Nos. 6/7, pp. 77–90.) A detailed description is given of the flying-spot scanning system for deriving a picture signal for modulating a television transmitter from transparent positives or negatives. The MC 13-16 c.r. tube used has magnetic focusing and deflection systems. Circuit means are indicated for correcting the signal for the afterglow of the fluorescent screen.

621.397.62 + 621.396.621 **1218**

Radio and Television at the 16th Salon National.—François. (See 1171.)

621.397.62 **1219**

Technical Description of a Television Receiver.—A. Bilotti. (*Rev. telegr. Electronica, Buenos Aires*, Sept. 1953, No. 492, pp. 555–560.) Detailed circuit diagram and component values are given for a receiver operating on the intercarrier system, to suit the Argentina television standards, namely, negative picture signal, line frequency 15 625 per sec, frame frequency 50 per sec, aspect ratio 3:4, f.m. sound, separation of 4·5 Mc/s between picture and sound carriers, channel width 6 Mc/s. Reception on all twelve v.h.f. channels is possible.

621.397.62 **1220**

The D.C. Component in Television.—W. T. Cocking. (*Wireless World*, Feb. 1954, Vol. 60, No. 2, pp. 63–66.) Birkinshaw's views (552 of February) are generally supported, but criticism is made of the well-known circuit in which the cathode of the c.r. tube is fed from the anode of the video stage through a voltage divider. The low input resistance of the tube thus connected may lead to a 50% reduction of the d.c. component. Various modifications of the coupling circuit are suggested for eliminating this defect.

621.397.62 **1221**

A Printed-Circuit Television Receiver.—G. Székely. (*Télévision*, Oct. 1953, No. 37, pp. 230–232.) Brief description of a new French receiver. All circuits, excepting timebases and supply, but including deflection coils, are printed.

621.397.62 : 535.623 **1222**

Improving the Transient Response of Television Receivers.—J. Avins, B. Harris & J. S. Horvath. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 274–284.) An examination is made of the delay distortion produced in the i.f. amplifier, and of the extent to which this is compensated by the peaking circuits of the video detector and amplifier. Factors determining cross-talk between the two colour-difference signals in the N.T.S.C. system are discussed. The use of a standard transmission monitor throughout the industry is recommended.

621.397.62 : 535.623 **1223**

Theory of Synchronous Demodulator as used in N.T.S.C. Color Television Receiver.—D. C. Livingston. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 284–287.) See 3129 of 1953.

621.397.62 : 535.623 **1224**

The D.C. Quadricorrelator: a Two-Mode Synchronization System.—D. Richman. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 288–299.) A description is given of an automatic-phase-control circuit adapted for colour synchronization in the N.T.S.C. system. The arrangement is simple, reliable and noise-immune. The pull-in and hold-in modes of operation are made indepen-

dent of each other by means of an automatic switch. See also *Convention Record Inst. Radio Engrs*, 1953, Part 4, pp. 13–23.

621.397.62 : 535.623 **1225**

Processing of the N.T.S.C. Color Signal for One-Gun Sequential Color Displays.—B. D. Loughlin. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 299–308.) Receiver arrangements of two types are described, namely those in which the colour subcarrier signal is modified, and those in which the luminance signal is modified. Circuits of the latter type generally demodulate the colour signal to some extent and correct the luminance signal to produce constant luminance.

621.397.62 : 535.623 **1226**

Compatible Color Picture Presentation with the Single Gun Tricolor Chromatron.—J. D. Gow & R. Dorr. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 308–315.) Techniques are discussed for operating the tube previously described [3131 of 1953 (Dressler)]. Circuit nonlinearity is corrected so as to ensure colour balance at different brightness levels.

621.397.62 : 535.623 **1227**

Improvements in the R.C.A. Three-Beam Shadow-Mask Color Kinescope.—M. J. Grimes, A. C. Grimm & J. F. Wilhelm. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 315–326.) Advances made since the original design [844 of 1952 (Law)] are described.

621.397.62 : 535.623 **1228**

The C.B.S.-Colortron: a Color Picture Tube of Advanced Design.—N. F. Fyler, W. E. Rowe & C. W. Cain. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 326–334.) Full details are given of a three-gun tricolour tube in which the phosphor dots are applied directly to the curved end-plate, and a self-supporting curved mask is provided. See also *Tele-Tech*, Nov. 1953, Vol. 12, No. 11, pp. 73, 150, 165.

621.397.62 : 535.623 **1229**

A Laboratory Receiver for Study of the N.T.S.C. Color Television System.—C. Masucci, J. J. Insalaco & R. Zitta. (*Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1, pp. 334–343.)

621.397.62 : 621.314.632 **1230**

Some High Frequency Effects in Germanium Diodes with Special Reference to Television Sound Detectors.—D. D. Jones & B. C. Brodribb. (*Electronic Engng*, Jan. 1954, Vol. 26, No. 311, pp. 33–35.) The measured performance of Ge diodes at h.f. may differ appreciably from that predicted from the static characteristics. The deviations, which may give rise to highly nonlinear detection, are shown to be consistent with hole-storage effects in the Ge; these effects can be eliminated by production techniques designed to reduce the lifetime of the holes. An indication is given of suitable test methods.

621.397.62 : 621.375.2 **1231**

Video Amplifier Design Charts.—W. K. Squires & H. L. Newman. (*Electronics*, Jan. 1954, Vol. 27, No. 1, pp. 190–192, 194.) Charts based on transient-response analysis are presented.

621.397.8 **1232**

Image Gradation, Graininess and Sharpness in Television and Motion-Picture Systems: Part 2 — The Grain Structure of Motion Picture Images — An Analysis of Deviations and Fluctuations of the Sample Number.—O. H. Schade. (*J. Soc. Mot. Pict. Telev. Engrs*, March 1952, Vol. 58, No. 3, pp. 181–222.) A treatment of aperture-response theory as applied to the evaluation of relative deviation in motion-picture processes. Part 1: 2293 of 1951.

621.397.8 **1233**

Image Gradation, Graininess and Sharpness in Television and Motion-Picture Systems: Part 3 — The Grain Structure of Television Images.—O. H. Schade. (*J. Soc. Mot. Pict. Telev. Engrs*, Aug. 1953, Vol. 61, No. 2, pp. 97–164.) An adequate description of granularity in television and motion-picture frames requires specification of the sine-wave spectrum and signal/deviation ratio in the retinal image as a function of luminance and for a specified viewing distance. An assessment of the perception of deviations can be made by introducing the characteristic of threshold signal/deviation ratios as the reference level. Part 2: 1232 above.

621.397.8 **1234**

Note on the Influence of Phase in Television.—A. Dubec. (*Onde élect.*, Nov. 1953, Vol. 33, No. 320, pp. 606–614.) Methods of calculating phase/frequency characteristics are reviewed in relation to the design of television receivers.

621.397.8 **1235**

Eye Movements in Connexion with Television Viewing.—M. P. Lord. (*Nature, Lond.*, 21st Nov. 1953, Vol. 172, No. 4386, pp. 964–965.) A comparison of movements made when viewing interlaced and sequentially scanned pictures indicates little difference; hence instability and 'crawling' associated with interlaced scan cannot be immediately explained in terms of the pattern of eye movements.

TRANSMISSION

621.375.227.029.4 : 621.3.018.783 **1236**

Nonlinear Distortion in a Class-B Push-Pull Amplifier with Transformer Output.—F. Böttcher. (*Telefunken Ztg*, Aug. 1953, Vol. 26, No. 101, pp. 313–322.) Expressions for the distortion, up to the 4th harmonic, are derived for the case of imperfect magnetic coupling between the halves of the primary winding of the output transformer. An approximate numerical calculation is made for the modulator output stage of an anode-modulated transmitter.

621.396.664 **1237**

Speech Clippers and their Operation.—W. Schreuer. (*Short Wave Mag.*, Oct. 1953, Vol. 11, No. 8, pp. 465–469.) Average modulation depth is increased without introducing overmodulation on voice peaks by using an amplitude limiter followed by a low-pass filter, with a cut-off frequency ~ 3 kc/s. High-level and low-level systems are discussed.

VALVES AND THERMIONICS

621.314.63 : 546.289 **1238**

Recovery Currents in Germanium p-n Junction Diodes.—R. G. Shulman & M. E. McMahon. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1267–1272.) When a diode biased in the forward direction has a reverse voltage suddenly applied, a large transient ('recovery') current flows. Values of this current based on a proposed mechanism involving diffusion of stored minority carriers to the barrier are compared with experimental results. The application to variable time-delay devices is discussed.

621.314.632 : 546.289 **1239**

Theory of the Forward Characteristic of Injecting Point Contacts.—P. C. Banbury. (*Proc. phys. Soc.*, 1st Oct.

1953, Vol. 66, No. 406B, pp. 833–840.) The voltage/current relation for forward voltages across a metal/semiconductor point contact is derived for the case when the current is carried by injected minority carriers. Unit injection ratio is assumed and recombination effects are neglected. Results of measurements on contacts under illumination and experimentally determined forward-voltage/current characteristics of a Ge-W rectifier are in satisfactory agreement with theory.

621.314.632 : 546.289 **1240**

Forward Characteristic of Injecting Area Contacts on Germanium.—H. K. Henisch & F. D. Morten. (*Proc. phys. Soc.*, 1st Oct. 1953, Vol. 66, No. 406B, pp. 841–844.) Measurements were made on 4·2-Ω.cm *n*-type and on 12-Ω.cm *p*-type Ge illuminated with white light. Au or Ag rectifying electrodes were used. The results found for the floating potential, the contact capacitance and the derived current/voltage barrier characteristic are given and compared with those derived from theory.

621.314.632 : 546.289 : 537.312.6 **1241**

Thermal Effects at Point-Contact Diodes.—P. M. Tipple & H. K. Henisch. (*Proc. phys. Soc.*, 1st Oct. 1953, Vol. 66, No. 406B, pp. 826–832.) Measurements, by a thermoelectric method, have been made of the contact temperature of a Ge diode, at several points on the voltage/current characteristics. The voltage turnover occurs at a critical contact temperature, which is constant for a given specimen. Also, the temperature gradients in the vicinity of a hot point contact may increase the contact resistance. This observation is discussed.

621.314.632 : 546.289 : 537.312.6 **1242**

Thermal Effects in Point-Contact Rectifiers.—H. L. Armstrong. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1332–1333.) The relation between thermal effects and the shape of the reverse characteristic is investigated for a Type-1N34 Ge rectifier.

621.314.632 : 621.397.62 **1243**

Some High Frequency Effects in Germanium Diodes with Special Reference to Television Sound Detectors.—Jones & Brodribb. (See 1230.)

621.314.7 **1244**

Design Theory of Junction Transistors.—J. M. Early. (*Bell Syst. tech. J.*, Nov. 1953, Vol. 32, No. 6, pp. 1271–1312.) "The small signal a.c. transmission characteristics of junction transistors are derived from physical structure and bias conditions. Effects of minority carrier flow and of depletion layer capacitances are analyzed for a one-dimensional model. The ohmic spreading resistance of the base region of a three-dimensional model is then approximated. Short-circuit admittances representing minority carrier flow, depletion layer capacitances, and ohmic base resistance elements are then combined into an equivalent circuit. Theoretical calculations are compared to observations for two typical designs."

621.314.7 : [546.28 + 546.289 **1245**

A Study of Carrier Injecting Properties of Emitter Contacts and Light Spots at Normal and Moderately Elevated Temperatures.—C. A. Hogarth. (*Proc. phys. Soc.*, 1st Oct. 1953, Vol. 66, No. 406B, pp. 845–858.) "The method of determining the injection efficiency γ of an emitter contact [described previously by Shockley, Pearson & Haynes (380 of 1950)] is discussed and some of the difficulties of the method and the interpretation of experimental results are described. The effects of a fine spot of white light when used as an emitter and hence as a conductivity modulator are investigated and an equivalent minority carrier current for a given optical assembly can be determined. This procedure suggests an experimental method for the determination of γ as a function of temperature. A simple theory for γ in terms of forbidden energy gap, depth of Fermi level, and barrier height ϕ is given and applied to the determination of barrier heights at room temperature, at elevated temperatures, and when an emitter contact on germanium is illuminated. Theoretical curves relating γ and ϕ are presented for Ge and Si of various impurity concentrations. The experiments carried out at elevated temperatures suggest that the surface states on germanium lie at the top of the filled band and that their density is of order 10^{10}–10^{11} cm^{-2}."

621.314.7 : 546.28 **1246**

Forming Silicon Point-Contact Transistors.—H. Jacobs, F. A. Brand & W. Matthei. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, p. 1340.) Particles of a suitable impurity material were pressed between a pointed tungsten electrode and the Si sample, and a high-density current was passed through the junction in a N_2 atmosphere. Best results were obtained using Sb to form *p-n-p* transistors and Al to form *n-p-n* transistors. Some test results are tabulated.

621.314.7 : 621.375.4.029.3 **1247**

Power Transistors for Audio Output Circuits.—L. J. Giacoletto. (*Electronics*, Jan. 1954, Vol. 27, No. 1, pp. 144–148.) Junction transistors cooled by liquids and by metal radiators are described. Analysis previously developed for small-signal operation is adapted to power operation, and the influence of finite base-lead resistance, temperature, frequency and source resistance is examined. Biasing arrangements for typical audio output circuits are discussed.

621.314.7 : 621.396.822 **1248**

Shot Noise in Junction Transistors.—H. C. Montgomery & M. A. Clark. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1337–1338.) The noise figure calculated from Montgomery's formula (643 of 1953) is in fair agreement with the values measured in a *p-n-p* alloy transistor at frequencies above those for which the noise is inversely proportional to frequency.

621.383.2 : 621.317 **1249**

The Photodianode.—G. Deloffre, É. Pierre & J. Roig. (*C. R. Acad. Sci., Paris*, 9th Dec. 1953, Vol. 237, No. 23, pp. 1507–1509.) The 'photodianode' is a tube with a plane photoemissive cathode and two linear anodes arranged parallel to and equidistant from the cathode. The anodes are connected via separate equal resistors to the positive supply terminal, thus there is a potential difference between them depending on the position of the illuminated area; this potential difference is determined by measuring the current through a galvanometer connected between the anodes. The arrangement responds to variations of the direction of a light beam, and can be used for accurate measurements of displacement and rotation.

621.383.4 **1250**

On the Relation between the Speed of Response and the Detectivity of Lead Sulfide Photoconductive Cells.—R. C. Jones. (*J. opt. Soc. Amer.*, Nov. 1953, Vol. 43, No. 11, pp. 1008–1013.)

621.383.5 : 546.23 **1251**

A New Type of Fatigue of Photocells.—G. Blet. (*C. R. Acad. Sci., Paris*, 11th Jan. 1954, Vol. 238, No. 2, pp. 228–230.) The impedance of a Se barrier-layer cell was found to drop immediately on illumination, returning to its original value only very slowly when the illumination was cut off. The suggested explanation is that the liberated photoelectrons suffer collisions which reduce their energy and hence delay their return to their original positions.

621.385 : 681.142 **1252**

Valve Reliability in Digital Calculating Machines.—Knight. (See 984.)

621.385.029.6 **1253**

Instabilities in the Smooth-Anode Cylindrical Magnetron.—L. A. Harris. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, p. 1335.) Correction to paper noted in 3293 of 1952. An error in equation (38) invalidates the previous conclusions. The system is stable, with a set of real characteristic frequencies.

621.385.032.213 **1254**

The Motion of Idealized Vacuum Tube Filaments under Shock.—H. S. Thomas. (*J. appl. Phys.*, Nov. 1953, Vol. 24, No. 11, pp. 1341–1342.) An analysis is made of the motion of an ideal clamped-end string; approximate formulae are derived for the maximum displacement for accelerations of the supports corresponding to three different types of shock. The results are applicable to the investigation of filament-to-grid shorting.

621.385.032.216 **1255**

Molded Thermionic Cathodes.—D. MacNair, R. T. Lynch & N. B. Hannay. (*J. appl. Phys.*, Oct. 1953, Vol. 24, No. 10, pp. 1335–1336.) The cathodes are made of sintered mixtures of Ni powder and (Ba, Sr)CO_3 on a Ni base. Test results indicate a very high resistance to deactivation by gases and ion bombardment. A comparison with sprayed oxide and other cathodes is made.

621.385.032.216 **1256**

Deterioration of Valve Performance due to Growth of Interface Resistance.—G. H. Metson & M. F. Holmes. (*P.O. elect. Engrs' J.*, Jan. 1954, Vol. 46, Part 4, pp. 198–199.) Results of measurements on a high-slope pentode indicate that the development of interface resistance between core and coating of the oxide cathode [2378 of 1952 (Child)] can be eliminated by replacing the usual Ni core by a material free from Si, e.g. commercially pure Pt. The lifetime of common receiving valves might thus be doubled.

621.385.032.216 : 546.831 **1257**

Thermionic Emission and Optical Emissivity of Zirconium.—G. Mesnard. (*Le Vide*, July/Sept. 1953, Vol. 8, Nos. 46/47, pp. 1392–1399.) Measurements were made of the properties of cathodes prepared by coating W or Mo wires with zirconium oxide. The activation by thermal treatment and the development of emission with time were studied. Spectral emissivity, resistance and required heating power are discussed. Similarities are noted between these cathodes and those using other materials, particularly thoria.

621.385.032.216 : 546.841.4-31 **1258**

Thermionic Properties of Thoria Coatings on Thoriated Molybdenum.—G. Mesnard. (*Le Vide*, July/Sept. 1953, Vol. 8, Nos. 46/47, pp. 1377–1383.) Measurements of the emission from (*a*) thoriated molybdenum, (*b*) thoria coatings on nonthoriated molybdenum, and (*c*) thoria coatings on thoriated molybdenum indicated that no appreciable advantage is obtained by thoriating the molybdenum base. The effects of treatment at high and at medium temperatures are discussed.

621.385.032.24 **1259**

Gold as a Grid Emission Inhibitor in the Presence of an Oxide-coated Cathode.—B. O. Baker. (*Brit. J. appl. Phys.*, Oct. 1953, Vol. 4, No. 10, pp. 311–315.) "Emission measurements have been made on gold-plated molybdenum and gold-plated manganese-nickel grids in the presence of an oxide-coated cathode. For grids which cannot be designed to operate below 350°C a minimum thickness of 1 μ of gold will suppress grid emission. Silver is not so reliable, but is effective in some cases."

621.385.2 : 621.316.722.1 **1260**

Characteristics of the Temperature-Limited Diode Type 29C1.—V. H. Attree: F. A. Benson & M. S. Seaman. (*Electronic Engng*, Jan. 1954, Vol. 26, No. 311, p. 42.) Comment on 595 of February and authors' reply.

621.385.3 : 621.396.822 **1261**

Experimental Investigation of Grid Noise.—N. Houlding & A. E. Glennie. (*Wireless Engr*, Feb. 1954, Vol. 31, No. 2, pp. 35–42.) "Results are given of a detailed investigation of triode noise factor, with particular reference to correlation of induced grid noise with shot noise. It is deduced that correlation is very slight and that, although the optimum value of noise factor can be calculated fairly accurately from the values of shot noise and optimum source resistance, the latter must be found by experiment and therefore the theory is not of major practical importance."

621.385.832 **1262**

Theory of the Triode Electron Gun with Cylindrical Symmetry.—É. Labin. (*Onde élect.*, Nov. & Dec. 1953, Vol. 33, Nos. 320 & 321, pp. 597–605 & 713–719.) Systems with nonrotational symmetry are considered, such as those used for producing ribbon beams. The method of conformal representation is used and formulae are derived based on purely electrostatic conditions; the validity of these formulae for operating conditions is examined.

621.385.832 : 681.142 **1263**

Recent Advances in Cathode-Ray-Tube Storage.—Williams, Kilburn, Litting, Edwards & Hoffman. (See 985.)

621.387 **1264**

Investigation of the use of Caesium Vapour in Thyratron-Type Gas-Filled Valves.—R. Coquerel. (*Le Vide*, July/Sept. 1953, Vol. 8, Nos. 46/47, pp. 1384–1391.)

621.387 : 621.318.572 **1265**

A New Cold-Cathode Decade Counter Tube.—H. v. Gugelberg. (*Helv. phys. Acta*, 16th Nov. 1953, Vol. 26, No. 6, pp. 586–588. In German.) Counting rates up to 10^5 pulses/sec have been obtained with experimental tubes using asymmetrical molybdenum cathodes.

621.387 : 621.318.572 **1266**

Cold-Cathode Tubes for Transmission of Audio-Frequency Signals.—M. A. Townsend & W. A. Depp. (*Bell Syst. tech. J.*, Nov. 1953, Vol. 32, No. 6, pp. 1371–1391.) The desirable transmission properties are discussed of tubes for use as switching elements in series with telephone circuits; performance curves for an experimental diode are given.

MISCELLANEOUS

621.39 **1267**

Some Recent Developments in Electronic Engineering.—(*Electronic Engng*, Jan. 1954, Vol. 26, No. 311, pp. 20–26.) Developments discussed include telemetering in guided missiles, radar and navigation aids and associated equipment for radio communication, equipment for meteorological investigations, computers, and apparatus for electromedical and industrial uses.

621.39 : 061.4 **1268**

Radio Industries at the 20th Salon de l'Aéronautique (26th June to 5th July 1953).—(*Onde élect.*, Nov. 1953, Vol. 33, No. 320, pp. 652–655.) A brief survey of equipment exhibited.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.2 **1269**

Saw-toothed Wave-forms in Sound.—G. J. Barber & T. F. W. Embleton. (*Nature, Lond.*, 5th Dec. 1953, Vol. 172, No. 4388, pp. 1057–1058.) An examination of the distortion of finite-amplitude pulses in which the leading half-cycle is a rarefaction.

534.2 **1270**

Scattering of Sound in a Turbulent Stream.—V. A. Krasil'nikov & V. I. Tatarski. (*C. R. Acad. Sci. U.R.S.S.*, 11th May 1953, Vol. 90, No. 2, pp. 159–162.) A theoretical treatment based on the assumption that the medium can be represented by the equation of an incompressible viscous fluid. In such a stream the scattering due to temperature inhomogeneities and to variations of the velocity are independent of each other and can be evaluated separately.

534.2 : 534.321.9 **1271**

The Fluctuations of Phase of Ultrasonic Waves propagated in the Ground Layer of the Air.—V. A. Krasil'nikov. (*C. R. Acad. Sci. U.R.S.S.*, 1st Feb. 1953, Vol. 88, No. 4, pp. 657–660. In Russian.) The r.m.s. phase deviation was determined from observations at frequencies up to 51 kc/s for various values of frequency and wind direction, distance between radiator and receiver, wind velocity, and time during which N observations were recorded. The apparatus used is described with the aid of a block diagram. The results are tabulated.

534.321.9 : 534.61 **1272**

The Dependence of the Power of Ultrasonic Radiation on Frequency.—S. Parthasarathy, D. Srinivasan & S. S. Chari. (*Z. Phys.*, 16th Oct. 1953, Vol. 136, No. 1, pp. 17–20.) The radiation intensities of the 3rd, 7th and 11th harmonics of a 1·44-Mc/s quartz crystal immersed in five organic liquids and excited at constant voltage were determined by thermal and direct radiation-pressure measurements. Radiated power decreases continuously as the order of harmonics increases.

534.321.9 : 534.613 **1273**

Mechanical Action of Ultrasonic Waves on Obstacles.—R. Lucas & E. Grossetti. (*C. R. Acad. Sci., Paris*, 25th Jan. 1954, Vol. 238, No. 4, pp. 458–459.) Experiments were made to check theoretically derived expressions for the force exerted by plane ultrasonic waves, using a torsion-balance method. The effects for highly reflecting and nonreflecting surfaces were compared. Obstacles of dimensions about 20 times the wavelength (λ = 1 mm) were used.

534.321.9 : 534.613 **1274**

An Investigation of the Absorption of 5-Mc/s Ultrasonic Waves in Organic Liquids by the Radiation Pressure Method.—S. Parthasarathy, S. S. Chari & D. Srinivasan. (*J. Phys. Radium*, Oct. 1953, Vol. 14, No. 10, pp. 541–546.) Measurements are reported of absorption in 47 liquids. See also 2543 of 1953.

534.321.9-14 **1275**

Variation of Ultrasonic Absorption with Frequency in Organic Liquids.—S. Parthasarathy, S. S. Chari & D. Srinivasan. (*Acustica*, 1953, Vol. 3, No. 5, pp. 363–364.) Certain results of radiation-pressure measurements at 5, 10 and 15 Mc/s lend support to the relaxation theory.

534.79 **1276**

The Relation between the Sone and Phon Scales of Loudness.—D. W. Robinson. (*Acustica*, 1953, Vol. 3, No. 5, pp. 344–358.) A set of statistically controlled experiments is described in which 35 subjects were required to judge two-fold and ten-fold increase and reduction of the loudness of tone and of noise. Loudness scales obtained showed a high consistency and a significant difference between scales relating to increase and to decrease of sensation. Results for loudness reduction are approximately expressed by the formula $\log S = 0{\cdot}029\,(P - 40)$ for the range 20–110 phons, P being the loudness level in phons, S the loudness sensation in sones. Results for free-field and earphone listening were similar.

534.83/.84 **1277**

Calculation of Sound Propagation in Structures.—L. Cremer. (*Acustica*, 1953, Vol. 3, No. 5, pp. 317–335.) Wavelength/frequency relations for sound waves propagated in different structural materials are calculated; critical frequencies for sound radiation from structural

elements are discussed. Mechanical impedance and the spectrum of impact sound are considered and an analysis is made of the effectiveness of suitable structural design in reducing the amplitude of longitudinal and flexural waves.

534.862.2 : 534.76 **1278**

Experiment in Stereophonic Sound.—L. D. Grignon. (*J. Soc. Mot. Pict. Telev. Engrs*, Sept. 1953, Vol. 61, No. 3, Part II, pp. 364–377. Discussion, pp. 377–379.) Microphone placing in stereophonic sound-film recording is discussed.

534.862.3/.4] : 534.76 : 621.395.625.3 **1279**

Stereophonic Recording and Reproducing Equipment.—J. G. Frayne & E. W. Templin. (*J. Soc. Mot. Pict. Telev. Engrs*, Sept. 1953, Vol. 61, No. 3, Part II, pp. 395–405. Discussion, pp. 405–407.) An outline description of some of the commercial equipment developed for the film industry.

534.862.3 : 534.76 : 621.395.625.3 **1280**

Multiple-Track Magnetic Heads.—K. Singer & M. Rettinger. (*J. Soc. Mot. Pict. Telev. Engrs*, Sept. 1953, Vol. 61, No. 3, Part II, pp. 390–394.) A brief description of the construction and characteristics of two six-track heads for the stereophonic recording of sound on film.

534.862.4 : 534.76 **1281**

Stereophonic Recording and Reproducing System.—H. Fletcher. (*J. Soc. Mot. Pict. Telev. Engrs*, Sept. 1953, Vol. 61, No. 3, Part II, pp. 355–361. Discussion, pp. 361–363.) A discussion of the amplifier and loudspeaker requirements for the reproduction of music at the original power level, in large halls, e.g. cinemas.

534.862.4 : 534.76 : 621.375.2 **1282**

New Theater Sound System for Multipurpose Use.—J. E. Volkmann, J. F. Byrd & J. D. Phyfe. (*J. Soc. Mot. Pict. Telev. Engrs*, Sept. 1953, Vol. 61, No. 3, Part II, pp. 408–414.) An outline description of two commercial multichannel power amplifiers.

534.862.4 : 534.76 : [621.395.623.7 + 621.375.2 **1283**

Loudspeakers and Amplifiers for Use with Stereophonic Reproduction in the Theater.—J. K. Hilliard. (*J. Soc. Mot. Pict. Telev. Engrs*, Sept. 1953, Vol. 61, No. 3, Part II, pp. 380–389. Discussion, p. 389.) A brief description of equipment and cinema installations.

534.87/.88 + 534.614 **1284**

The Development of Acoustic Sea-Depth Measurements.—Drubba & Rust. (See 1430.)

621.395.61 **1285**

Directional Dynamic Microphones.—(*Radio Tech., Vienna*, Dec. 1953, Vol. 29, No. 12, pp. 420–422.) Microphones developed in Austria are described. One type comprises two dynamic systems with individual cardioid characteristics, which can be combined to provide omnidirectional or figure-of-eight characteristics as required.

621.395.61 **1286**

The Directivity of Spherical Microphones.—R. L. Pritchard. (*Acustica*, 1953, Vol. 3, No. 5, pp. 359–362.) The directional response of a cylindrical microphone mounted in a sphere is calculated by considering the sound field radiated from a spherical cap and applying the reciprocity principle. This principle is also used to derive the frequency response of a completely spherical microphone. Results are compared with those of Kuhl (613 of 1953); good agreement is shown except in the case of Kuhl's calculated values for response at angles between 160° and 180°.

621.395.625.3 **1287**

Studies on Magnetic Recording: Part 5—Comparison with Experiments. Part 6—Change in the Recording with Time.—W. K. Westmijze. (*Philips Res. Rep.*, Oct. 1953, Vol. 8, No. 5, pp. 343–366.) Print effect and time-lag effects are discussed. 45 references. Parts 3 and 4: 324 of February.

621.395.625.3 **1288**

The Difference between Pre-echo and Post-echo in the Print-Through Effect.—J. Greiner. (*Nachr Tech.*, Nov. & Dec. 1953, Vol. 3, Nos. 11 & 12, pp. 506–509 & 543–545, 573.) A report of theoretical and experimental investigations of the print-through effect in magnetic-tape recording.

631.395.625.3 **1289**

The Effect of High-Frequency Biasing in Magnetic [tape] **Recording.**—W. Albach. (*Funk u. Ton*, Dec. 1953, Vol. 7, No. 12, pp. 628–630.) The improvement obtained by using h.f. biasing is explained as resulting from reduced hysteresis in the magnetization process.

621.395.625.3 : 621.385.832 **1290**

Visual Monitor for Magnetic Tape.—R. L. Miller. (*J. Soc. Mot. Pict. Telev. Engrs*, Sept. 1953, Vol. 61, No. 3, Part I, pp. 309–312. Discussion, pp. 313–315.) The monitor comprises a c.r. tube with the second anode forming a section of the tube wall. The tape is passed over a saddle formed in the second anode, and the beam deflection due to the magnetic recording is displayed on the fluorescent screen.

621.395.625.3 : 621.397.5 **1291**

The Status of Magnetic Recording.—R. E. Zenner. (*Elect. Engng, N.Y.*, Nov. 1953, Vol. 72, No. 11, pp. 951–954.) Limitations of magnetic-tape systems are discussed in relation to the recording of (*a*) sound, (*b*) digital data, (*c*) physical analogue data, and (*d*) video signals.

AERIALS AND TRANSMISSION LINES

621.315.212 **1292**

The Manufacture, Laying and Splicing of Coaxial-Pair Cable.—C. Lancoud. (*Bull. schweiz. elektrotech. Ver.*, 3rd Oct. 1953, Vol. 44, No. 20, pp. 875–880. In French.) A short account, with special reference to Swiss practice.

621.372.2 **1293**

The E-H Surface Wave.—A. E. Karbowiak. (*Wireless Engr*, March 1954, Vol. 31, No. 3, pp. 71–73.) The field equations of the travelling E-H surface wave are derived, and an analysis is made of transmission along helical conductors.

621.372.2 **1294**

Transmission-Line Impedance and Efficiency.—W. W. Macalpine. (*Elect. Engng, N.Y.*, Oct. 1953, Vol. 72, No. 10, p. 868.) Digest only. A method is presented for computing the resistance and the efficiency of a line when the voltage s.w.r. is high. For full paper see *Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, pp. 334–339 or *Elect. Commun.*, Sept. 1953, Vol. 30, No. 3, pp. 238–246.

621.372.2 **1295**

Irregular Transmission Lines.—A. Rosen. (*Wireless Engr*, March 1954, Vol. 31, No. 3, pp. 59–70.) The Kennelly method of successive reflections is developed to give general expressions for the voltage and current in an irregular line. The expressions are simplified for the case where the impedance deviations are small, e.g. for coaxial cable used for wide-band telephone and television transmission. The formulae are given in series form for

the case where the impedance changes abruptly, and in integral form for the case of continuous impedance changes. The effects of irregularities on the open- and short-circuit impedances are discussed.

621.372.2.029.64/.65 + 621.396.621.029.64 **1296**

Experimental Determination of the Properties of Microstrip Components.—M. Arditi. (*Elect. Commun.*, Dec. 1953, Vol. 30, No. 4, pp. 283–293; *Convention Record Inst. Radio Engrs*, 1953, Part 10, pp. 27–37.) The components investigated include coaxial-to-microstrip matching units, bends, transverse posts, offset junctions, step discontinuities, gaps or slots in the strip conductor, parallel-coupled junctions and directional couplers. A microwave receiver is described in which the whole r.f. circuit except the high-Q cavity resonator consists of microstrip parts.

621.372.21 **1297**

Calculation of the Attenuation and Distortion of Travelling Waves.—K. Moritz. (*Arch. Elektrotech.*, 1953, Vol. 41, No. 3, pp. 160–180.) Mathematical investigation of the propagation of a voltage pulse along a line with an earth return. The losses due to earth eddy currents and corona are taken into consideration; line-resistance losses are neglected.

621.372.8 + 621.372.2 **1298**

TEM Waves in Cylindrical Systems.—P. Moon & D. E. Spencer. (*J. Franklin Inst.*, Oct. 1953, Vol. 256, No. 4, pp. 325–336.) Two simple and rigorous theoretical treatments are presented, namely (*a*) use of the vector Laplacian operator, and (*b*) introduction of a quasi-potential. Equations derived are free from ambiguities and yield simple solutions for **E** and **H** even with complex coordinate systems.

621.372.8 **1299**

Attenuation in Nickel and Mild-Steel Waveguides at 9375 Mc/s.—F. A. Benson. (*Proc. Instn elect. Engrs*, Part III, Jan. 1954, Vol. 101, No. 69, pp. 38–41.) Measurements on rectangular waveguides are reported. Mild-steel guides with machined internal surfaces have attenuation as high as 3·79 db/m, while the permeability of Ni deduced from attenuation measurements on commercial drawn tubing, taking account of surface roughness, was ~ 3.

621.372.8 : 538.614 **1300**

Guided Electromagnetic Waves in Anisotropic Media.—A. A. T. M. van Trier. (*Appl. sci. Res.*, Vol. B3, Nos. 4/5, pp. 305–371.) Theory of guided waves in isotropic media is surveyed; a general formulation of the theory for anisotropic media is presented, and particular waveguide structures are analysed. A cavity technique for measuring Faraday rotations is described and experimental results obtained with ferroxcube IVA, B, C, D and E are presented. The physical interpretation of the results is discussed with reference to Rado's theory of the permeability tensor in nonsaturated ferromagnetics (1709 of 1953).

621.396.67 **1301**

Modern Aerial Theories.—P. Neidhardt. (*NachrTech.*, Nov. 1953, Vol. 3, No. 11, pp. 487–492.) A comparative survey with 44 references.

621.396.67 **1302**

Calculation of the Distribution of Current in Thin [linear] Aerials.—R. Sartori. (*Alta Frequenza*, Dec. 1953, Vol. 22, No. 6, pp. 258–281.) Energy considerations lead to a simple way of deriving a general equation for the current distribution, which includes Hallén's equation as a particular case.

621.396.67 : 621.397.5 **1303**

Control of Vertical Radiation Patterns of TV Transmitting Antennas.—F. G. Kear & J. G. Preston. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, pp. 402–407.) Earlier U.S.A. designs concentrating as much of the energy as possible into the horizontal plane are being modified to improve the coverage of the service area. As an example, the 6-bay superturnstile aerial on Mt Wilson has been modified to radiate 2·1 times as much power below the horizontal as above.

621.396.677.45 **1304**

Wide-Frequency-Range Tuned Helical Antennas and Circuits.—A. G. Kandoian & W. Sichak. (*Elect. Commun.*, Dec. 1953, Vol. 30, No. 4, pp. 294–299; *Convention Record Inst. Radio Engrs*, 1953, Part 2, pp. 42–47.) A discussion of helical aerials of diameter small compared with λ. Using a shunt-feed arrangement with a variable tap point and a variable short-circuit, tuning ranges up to 100 : 1 can be obtained.

621.396.677.7 **1305**

Radiation from the Open End of a Lecher Line or Waveguide at a Great Distance from the Opening.—H. Florian. (*Acta phys. austriaca*, Oct. 1953, Vol. 8, No. 1, pp. 42–62.) Schelkunoff's analysis (1779 of 1936) is extended; results are obtained in the form of solvable integrals suitable for practical calculations. Waveguides of rectangular and circular section and coaxial lines are considered.

621.396.677.71 **1306**

Propagation along a Slotted Cylinder.—R. F. Harrington. (*J. appl. Phys.*, Nov. 1953, Vol. 24, No. 11, pp. 1366–1371.) A variational method is presented for determining the attenuation and phase constants for the field of a travelling-wave slot aerial using a circular-section waveguide. Calculated and experimentally determined values are compared for the cases of excitation in the TE_{11} and TM_{01} modes.

621.396.677.71 **1307**

Traveling-Wave Slot Antennas.—V. H. Rumsey. (*J. appl. Phys.*, Nov. 1953, Vol. 24, No. 11, pp. 1358–1365.) A variational method, making use of the generalized reciprocity theorem for travelling-wave line sources, is used to derive approximate formulae for the propagation constant and characteristic field pattern for travelling-wave slot aerials containing a dielectric. For the case of the rectangular-section aerial containing only air, results calculated from the theory are in good agreement with measured values. See also 334 of February (Hines et al.).

621.396.677.75 **1308**

Propagation and Radiation of Electromagnetic Waves along a Dielectric Line with Nonuniform Characteristics.—J. C. Simon & G. Weill. (*C. R. Acad. Sci., Paris*, 4th Jan. 1954, Vol. 238, No. 1, pp. 57–59.) Long aerials comprising nonuniform dielectric lines are discussed, and a method based on the concept of space harmonics is presented for calculating the relation between the radiation and the periodic characteristics of the line.

AUTOMATIC COMPUTERS

681.142 **1309**

An Analogue-Type Multiplier.—J. Isabeau. (*HF, Brussels*, 1953, Vol. 2, No. 8, pp. 213–218.) A simple multiplying circuit is described in which 12-kc/s rectangular pulses are modulated successively in width and amplitude in proportion respectively to the two factors, A and B, to be multiplied. Response times for the circuit tested were 1–10 ms for the factor A (amplitude 5–100 V) and 20 ms irrespective of amplitude for B (0–120 V).

681.142 **1310**

A Simple Electronic Multiplier.—K. H. Norsworthy. (*Electronic Engng*, Feb. 1954, Vol. 26, No. 312, pp. 72–75.) The multiplication process described is based on the equation $(X + Y)^2 - (X - Y)^2 = 4XY$. A method of squaring is used which depends on the fact that the areas of similar triangles are proportional to the squares of their heights; a triangular-waveform generator is described. The device accepts both positive and negative input voltages.

681.142 **1311**

Electronic Analogue Computing.—R. B. Quarmby. (*Wireless World*, March 1954, Vol. 60, No. 3, pp. 113–118.) A survey of modern techniques; an indication is given of the kind of problem for which analogue computers offer advantages over digital types.

681.142 **1312**

A New Analogue Computer.—E. L. Thomas. (*Engineering, Lond.*, 9th Oct. 1953, Vol. 176, No. 4576, pp. 477–479.) A general-purpose computer of differential-analyser type, designed for economic quantity production, is described. Three basic elements are used, viz., (*a*) scaling units, essentially 3-decade variable resistors, (*b*) function units comprising *RC* networks, (*c*) high-gain amplifiers. Facilities for c.r.o. and graphical display are provided.

681.142 **1313**

Note on High-Speed Product Integrator.—I. Cederbaum. (*Rev. sci. Instrum.*, Nov. 1953, Vol. 24, No. 11, pp. 1072–1073.) Errors arising in the potentiometer circuit of the integrator [2058 of 1953 (Macnee)] are discussed.

681.142 **1314**

General Survey of the Operating Principles of Electrical Analogue Computers.—C. Mounier. (*Rev. gén. Elect.*, Nov. 1953, Vol. 62, No. 11, pp. 515–530.) A survey with particular reference to computers constructed by the Société d'Electronique et d'Automatisme; difficulties encountered in studying the accuracy of these machines are discussed.

681.142 **1315**

A Diode-Capacitor Memory for High-Speed Electronic Computers.—(*Tech. News Bull. nat. Bur. Stand.*, Nov. 1953, Vol. 37, No. 11, pp. 171–173.) Ordinary linear capacitors are used as rapid-access storage elements in a matrix arrangement. The basic circuit consists of two diodes in series, with the anode of one connected to the cathode of the other, and the capacitor connected to the junction; the other end of the capacitor is used for reading and writing, and is connected to earth through a resistor.

681.142 **1316**

A Survey of Digital Computer Memory Systems.—J. P. Eckert, Jr. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, p. 413.) Correction to paper abstracted in 41 of January.

681.142 **1317**

Frequency Analysis of Digital Computers operating in Real Time.—J. M. Salzer. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, pp. 457–466.)

681.142 : 512 **1318**

Elements of Boolean Algebra for the Study of Information-Handling Systems.—R. Serrell. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, p. 475.) Correction to paper abstracted in 57 of January.

681.142 : 53 **1319**

Application of Digital Computing Techniques to Physics.—R. A. Brooker. (*Brit. J. appl. Phys.*, Nov. 1953, Vol. 4, No. 11, pp. 321–326.) Problems involving matrices, ordinary and partial differential equations, functions occurring in crystallography and the 'random walk' statistical method are discussed. Machine design and the training of personnel are considered briefly.

681.142 : [538.221 + 537.226 **1320**

Magnetic and Dielectric Elements for Computers.—F. van Tongerloo. (*Tijdschr. ned. Radiogenoot.*, Nov. 1953, Vol. 18, Nos. 5/6, pp. 265–285.) A survey of the applications of materials with rectangular hysteresis loops. Two classes are distinguished, namely (*a*) those depending on a high ratio of remanence to saturation, and (*b*) those for which the 'squareness ratio' is important.

681.142 : 621.373.42 **1321**

A Low-Frequency Oscillator.—R. M. Howe & R. J. Leite. (*Rev. sci. Instrum.*, Oct. 1953, Vol. 24, No. 10, pp. 901–903.) An analogue computer for solving the differential equations of a mass/spring system comprises a circuit producing simple harmonic oscillations with a frequency range of 0·0016–16 c/s.

681.142 : 621.376.22 **1322**

Instantaneous Multiplier for Computers.—M. Mehron & W. Otto. (*Electronics*, Feb. 1954, Vol. 27, No. 2, pp. 144–148.) Multiplication is performed by means of balanced modulators using standard i.f. transformers and other components.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.018.75 : 621.387.4 **1323**

Pulse-Height Analyzer.—J. W. Thomas, V. V. Verbinski & W. E. Stephens. (*Rev. sci. Instrum.*, Nov. 1953, Vol. 24, No. 11, pp. 1017–1020.) The equipment, based on Wilkinson's conversion principle (1085 of 1951), has resolution, linearity and stability to within 1%. It can deal with input pulses at a rate of several thousand per second. Recording is made on Teledeltos paper at a rate of up to 50 pulses/sec.

621.3.018.78 **1324**

A New General Method for Frequency-Distortion Correction of a Given Circuit in Light-Current and Instrument Engineering.—M. Hájková-Jančová. (*Frequenz*, Sept. 1953, Vol. 7, No. 9, pp. 268–269.) The frequency-dependent function, e.g. the amplification factor, is expressed as the ratio of power series of functions of the frequency, and the condition for a minimal frequency dependence is found.

621.3.018.78 : 621.376.3 **1325**

Normalized Phase and Gain Derivatives as an Aid in Evaluation of F.M. Distortion.—J. J. Hupert. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, pp. 438–446.) The method previously described for evaluating the distortion for the quasistationary condition (3550 of 1953) is extended to take account of the finite rate of variation of the input-signal frequency.

621.314.7 : 621.3.015.3 **1326**

Transient Response of the Grounded-Base Transistor Amplifier with Small Load Impedance.—J. S. Schaffner & J. J. Suran. (*J. appl. Phys.*, Nov. 1953, Vol. 24, No. 11, pp. 1355–1357.) A transfer function relating junction-transistor collector current to emitter current is derived from the diffusion equation; the Laplace-transform technique is used to determine the variation of collector current in response to a step variation of emitter current. Collector-current rise times evaluated from the theory are in good agreement with observed values. See also 3513 of 1953 (Chow & Suran).

621.316.86 : 537.312.6 **1327**

Thermistor Production.—W. T. Gibson. (*Elect. Commun.*, Dec. 1953, Vol. 30, No. 4, pp. 263–270.) Reprint, with additional illustrations, of paper abstracted in 2240 of 1953.

621.318.4 **1328**

Tapped Inductances.—C. R. Cosens. (*Wireless Engr*, March 1954, Vol. 31, No. 3, pp. 74–75.) 'Maxwell coils' for a.f. are considered, and a simple method is presented for calculating the position of the tapping to give a specified fraction of the total inductance.

621.372.011.012 **1329**

Graphical Analysis of Nonlinear Circuits using Impedance Concepts.—J. S. Thomsen. (*J. appl. Phys.*, Nov. 1953, Vol. 24, No. 11, pp. 1379–1382.) Approximate values of the reactance of moderately nonlinear inductors and capacitors are obtained by adding to the usual linear expressions terms involving the square of the current. Using this approximation, the total impedance of an *LRC* circuit is obtained and plotted in the *I-Z* plane, with frequency as a parameter. The method gives a physical picture of the jump phenomenon in nonlinear circuits.

621.372.413 **1330**

Large Reduction of Free Electromagnetic Oscillations in Cylindrical Regions due to Slight Departures from Cylindricity.—Yu. S. Sayasov. (*C. R. Acad. Sci. U.R.S.S.*, 11th May 1953, Vol. 90, No. 2, pp. 163–166.) A theoretical investigation of the effect of small deformations on long cylindrical resonators with perfectly conducting walls. The diminution of the field is proportional to the product of the relative distortion and the square of the ratio of the length of the cylinder to its radius. Standard mathematical notation is used and the expressions for E_r, E_θ and H_ϕ are given in terms of Bessel functions and the function M_{0p} which is defined as the pth root of J_0.

621.372.413 : 517.9 **1331**

An Asymmetrical Finite Difference Network.—R. H. Macneal. (*Quart. appl. Math.*, Oct. 1953, Vol. 11, No. 3, pp. 295–310.) A study is made of a method of solving boundary-value problems by means of electrical network analogies. Consideration is given to the special problems associated with curved boundaries and with the use of meshes of different size at different parts of the network. A method is described by means of which the coefficients of the system of algebraic equations can be computed for an arbitrary distribution of node points, and the position of the nodes can then be chosen to fit the particular conditions. As an illustration, the resonance frequencies and field patterns of a conical-line cavity resonator are calculated.

621.372.5 **1332**

A General *RLC* Synthesis Procedure.—L. Weinberg. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, pp. 427–437; *Convention Record Inst. Radio Engrs*, 1953, Part 5, pp. 2–16.) Procedure for synthesizing lattice networks is described.

621.372.5 **1333**

Unbalanced *RLC* Networks containing Only One Resistance and One Real Transformer.—L. Weinberg. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, pp. 467–475; *Trans. Inst. Radio Engrs*, Dec. 1953, No. PGCT-2, pp. 55–65.)

621.372.5 **1334**

Unilateral Four-Terminal Circuits.—J. S. Foley. (*Electronics*, Feb. 1954, Vol. 27, No. 2, pp. 186–187.) Networks of Ge diodes and carbon resistors, suitable for purposes of directional coupling and isolating, are described.

621.372.512.24 **1335**

High-Q Coupled Tuned Circuits.—H. D. Polishuk. (*Wireless Engr*, March 1954, Vol. 31, No. 3, pp. 55–58.) "By means of a set of expressions developed as functions of a frequency ratio, some aspects of inductively-coupled high-Q resonant circuits are analysed. Considerations of finite, very high-Q circuits lead to simple relations determining impedance characteristics of a fundamental system, resonant frequencies, rate of frequency deviation input conductance, stored energy and power dissipation ratios."

621.372.54 **1336**

Two New Equations for the Design of Filters.—M. Dishal. (*Elect. Commun.*, Dec. 1953, Vol. 30, No. 4, pp. 324–337; condensed version, *Convention Record Inst. Radio Engrs*, 1953, Part 5, pp. 44–47.) Equations are presented for designing constant-K-configuration filters with Tchebycheff-type characteristics, for the case when the unloaded Q of the elements is sufficiently high for them to be considered nondissipative. Both band-pass and low-pass filters are considered; the band-pass examples are mainly for u.h.f.

621.372.54 **1337**

Old and New Methods for designing Composite High-Frequency Filter Circuits and their Application to Filter Circuits with Low Relative Bandwidth.—R. Rücklin. (*Arch. elekt. Übertragung*, Nov. 1953, Vol. 7, No. 11, p. 554.) Correction to paper abstracted in 84 of January.

621.372.54 **1338**

Nonlinear Filters.—W. D. White : L. A. Zadeh. (*J. appl. Phys.*, Nov. 1953, Vol. 24, No. 11, pp. 1412–1413.) Comment on 2598 of 1953 and author's reply.

621.372.54 : 538.652 **1339**

Electromechanical Filters.—S. P. Lapin. (*Radio & Telev. News, Radio-Electronic Engng Section*, Dec. 1953, Vol. 50, No. 6, pp. 9–11..37.) Design and performance data are presented for i.f. filters for the frequency range 100–1 000 kc/s, of the type comprising metal-plate resonators interconnected by pairs of fine metal wires.

621.372.542.2 **1340**

A General Tchebycheff Rational Function.—C. B. Sharpe. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, pp. 454–457.) The derivation is described of a function useful for the design of low-pass filters.

621.372.543.2 : 621.375.232.029.4 **1341**

Electronic Audio Bandpass Filter.—R. J. Gunderman. (*Radio & Telev. News, Radio-Electronic Engng Section*, Nov. 1953, Vol. 50, No. 5, pp. 16..23.) A narrow-band filter with centre frequency adjustable from 20 to 5 000 c/s is obtained by including a phase-inverter rejection circuit in the negative-feedback circuit of an audio amplifier.

621.372.56 **1342**

Attenuator Design.—N. H. Crowhurst. (*Electronic Engng*, Feb. 1954, Vol. 26, No. 312, pp. 76–78.) A chart is given for the design of constant-resistance types of attenuator.

621.372.6 **1343**

Some Not Necessarily Linear $(n + 1)$-Poles.—A. Stöhr. (*Arch. elekt. Übertragung*, Nov. 1953, Vol. 7, No. 11, pp. 546–548.) In $(n + 1)$-poles composed of linear 2-poles, and in some other $(n + 1)$-poles, linear relations

exist between the voltages and the currents, and the resulting impedance matrix is symmetrical. A generalization, to include nonlinear relations, is given by the condition that $\partial(\phi_k - \phi_j)/\partial i_l$ must be symmetrical in k and l, where $(\phi_k - \phi_0)$ is the p.d. between the kth and the zeroth terminal and i_l is the current flowing into the lth terminal. Examples and properties of such $(n + 1)$-poles are given.

621.373 **1344**

The Use of Admittance Diagrams in Oscillator Analysis.—H. J. Reich. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, pp. 484–485.) Discussion on 1944 of 1953.

621.373.421 **1345**

A New Type of *RC* Oscillator.—G. Francini & E. Zaccheroni. (*Alta Frequenza*, Dec. 1953, Vol. 22, No. 6, pp. 282–294.) A circuit requiring a much smaller amount of valve amplification than the usual phase-shift oscillator uses a specially designed twin-T feedback network.

621.373.421 + 621.375.23].001.2 **1346**

Block-Diagram Analysis of Vacuum-Tube Circuits.—T. M. Stout. (*Elect. Engng, N.Y.*, Oct. 1953, Vol. 72, No. 10, p. 900.) Digest only. The method is illustrated by analyses of (*a*) an amplifier with current feedback from the cathode circuit and (*b*) a phase-shift oscillator.

621.373.422 : 621.376.2/.3 **1347**

Amplitude Variations in a Frequency-Modulated Oscillator.—W. J. Cunningham. (*J. Franklin Inst.*, Oct. 1953, Vol. 256, No. 4, pp. 311–323.) Analysis indicates how unwanted a.m. is produced when f.m. is accomplished by varying the capacitance in a negative-resistance oscillator circuit. A numerical example is given.

621.373.43 **1348**

The Design of the Eccles-Jordan Circuit.—R. Piloty, Jr. (*Arch. elekt. Übertragung*, Nov. 1953, Vol. 7, No. 11, pp. 537–545.) Design formulae are derived from a fundamental analysis of the circuit. Their application is illustrated in the design of a high-stability, 2-Mc/s flip-flop circuit using a Type-E90CC valve.

621.373.43 **1349**

The Electronic Switch.—E. Piepgras. (*Funk u. Ton*, Nov. 1953, Vol. 7, No. 11, pp. 580–589.) An analysis of the operation of square-wave generators.

621.373.431.1 : 621.318.572 **1350**

Bi-Stable Multivibrator Analysis.—P. A. Neeteson. (*Electronic Applic. Bull.*, Aug./Sept. 1953, Vol. 14, Nos. 8/9, pp. 121–137.) Continuation of paper abstracted in 1006 of April. The operational calculus is used to analyse the Eccles-Jordan flip-flop circuit.

621.373.432 : 621.387 **1351**

Control of Glow-Discharge Triodes by means of Very Small Currents.—E. Meili. (*Helv. phys. Acta*, 16th Nov. 1953, Vol. 26, No. 6, pp. 574–577. In German.) A discussion of the desirable characteristics of a valve suitable for the generation of sawtooth oscillations, using a grid-cathode capacitor of value between 10 and 50 pF and a grid control current as low as 3×10^{-11} A. The essential design points are (*a*) small cross-sectional area of the discharge space, (*b*) high current density at low currents, (*c*) short ion transit times and (*d*) large difference between the striking and the operating potential. These are achieved by arranging a wire-point control electrode close to the cathode.

621.373.52 **1352**

An Amplitude-Stabilized Transistor Oscillator.—E. R. Kretzmer. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, pp. 391–401.) An a.f. oscillator using two junction transistors in push-pull class-C operation has its amplitude stabilized to within 1% over wide ranges of supply voltage, loading and temperature by comparing the output with a stable reference voltage obtained from a junction diode operated at breakdown.

621.374.4 : 621.376.233 **1353**

The Efficiency of Frequency Multipliers using Detector Circuits.—G. B. Hagen. (*NachrTech.*, Nov. 1953, Vol. 3, No. 11, pp. 482–486.) An analysis is made of the harmonic-frequency power obtainable in an oscillatory circuit connected to a generator via a detector whose characteristic is represented approximately by a hyperbola. For harmonics of fourth and higher orders the calculations become very difficult; it cannot be assumed that for any given harmonic the power is less than for the next lower harmonic.

621.375.121.029.4/.5 **1354**

Design of Wide-Band Tuned Amplifiers.—F. Jaeschke. (*Funk u. Ton*, Oct.–Dec. 1953, Vol. 7, Nos. 10–12, pp. 508–516, 570–579 & 630–642.) Amplifiers with Schienemann (Butterworth) and Tchebycheff band-pass characteristics are considered in detail and formulae, design curves and numerical examples are given.

621.375.2 + 621.395.623.7] : 534.862.4 : 534.76 **1355**

Loudspeakers and Amplifiers for Use with Stereophonic Reproduction in the Theater.—J. K. Hilliard. (*J. Soc. Mot. Pict. Telev. Engrs*, Sept. 1953, Vol. 61, No. 3, Part II, pp. 380–389. Discussion, p. 389.) A brief description of equipment and cinema installations.

621.375.2 : 621.395.44 **1356**

The Coaxial-Line Amplifier.—Bauer. (See 1572.)

621.375.2.024 **1357**

D.C. Amplifiers.—J. Yarwood & D. H. Le Croissette. (*Electronic Engng*, Jan.–March 1954, Vol. 26, Nos. 311–313, pp. 14–19, 64–70 & 114–117.) A survey paper with 81 references.

621.375.2.024 **1358**

Investigation of the Effect of Unbypassed Screen-Grid Resistors on Amplification Factor.—E. G. Woschni. (*NachrTech.*, Oct. 1953, Vol. 3, No. 10, pp. 444–446.) A calculation is made of the negative feedback introduced by unbypassed resistors in the screen-grid lead; this arrangement is usual in d.c. amplifiers. Experimental results confirming the theory are presented.

621.375.221.2 **1359**

Distributed Amplifiers: Some New Methods for Controlling Gain/Frequency and Transient Responses of Amplifiers having Moderate Bandwidths.—H. G. Bassett & L. C. Kelly. (*Proc. Instn elect. Engrs*, Part III, Jan. 1954, Vol. 101, No. 69, pp. 5–14.) Distributed amplifiers of moderate bandwidths for steady-state applications may be constructed for almost constant gain up to 80% or 90% of cut-off by methods including the insertion of extra sections into the networks or the use of networks whose image impedance at a shunt-capacitance point falls to zero at the cut-off frequency. For waveform amplification, the use of *m*-derived low-pass networks with added resistive elements is suggested. The image delay is then almost constant over 85% of the non-dissipative pass band, and the image attenuation varies in approximately Gaussian fashion with frequency over most of the pass band. In this second case the maximum useful number of valves per stage is five.

621.375.23 **1360**

Development of a High-Fidelity Preamplifier for Use in the Recording of Bioelectric Potentials with Intracellular Electrodes.—S. J. Solms, W. L. Nastuk & J. T. Alexander. (*Rev. sci. Instrum.*, Oct. 1953, Vol. 24, No. 10, pp. 960–967.) The cathode-follower circuit conventionally used to minimize the time constant of the recording system is discussed and its shortcomings are analysed. An improved circuit using positive feedback is described.

621.375.23 : 621.3.016.35 **1361**

Gain Stability of Feedback Amplifiers.—D. L. H. Gibbings & A. M. Thompson. (*Proc. Instn elect. Engrs*, Part III, Jan. 1954, Vol. 101, No. 69, pp. 35–37.) By proper choice of the phase angle of the loop gain, either the magnitude or the phase angle of the amplifier gain may be made independent, to a first order, of changes in the active elements. The general theory is developed. Results obtained with an experimental amplifier show that, over a narrow frequency range, the unit can be made as stable as the passive components in the feedback network.

621.375.23.029.42 **1362**

A Low-Frequency Selective Amplifier.—F. M. Gardner. (*Trans. Inst. Radio Engrs*, Nov./Dec. 1953, Vol. AU-1, No. 6, pp. 10–12.) Analysis similar to that for a simple resonant circuit is presented for a feedback amplifier. Design and performance of an amplifier with a resonance frequency of about 30 c/s are outlined.

621.375.232 **1363**

A Minimal Noise Preamplifier for Proportional Counters and Similar Applications.—K. Enslein & B. Brainerd. (*Rev. sci. Instrum.*, Oct. 1953, Vol. 24, No. 10, pp. 916–919.) A negative-feedback amplifier is described which is linear over an input range of 74 db. The maximum gain is 1 900, and is attained over a frequency range of about 10–500 kc/s. Signals of 2 μV can be recognized.

621.375.3 **1364**

Fast Response of Magnetic Amplifiers.—D. G. Scorgie. (*Elect. Engng, N.Y.*, Nov. 1953, Vol. 72, No. 11, p. 973.) Digest of paper to be published in *Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72.

621.375.3 : 538.245 **1365**

Instability of Self-Saturating Magnetic Amplifiers.—S. B. Batdorf & W. N. Johnson. (*Elect. Engng, N.Y.*, Nov. 1953, Vol. 72, No. 11, p. 1013.) Digest of paper to be published in *Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72. Differences between the major and the minor hysteresis loops of hipernik 5 and their importance in d.c. triggering are discussed.

621.375.4 **1366**

Gain-Stabilized Transistor Amplifier.—C. A. Krause. (*Electronics*, Feb. 1954, Vol. 27, No. 2, pp. 183–185.) Gain is stabilized by using an unbypassed resistor in the emitter circuit of a junction transistor.

621.375.4.024 **1367**

D.C. Amplifier employing Junction-Type Transistors.—E. Keonjian. (*Elect. Engng, N.Y.*, Nov. 1953, Vol. 72, No. 11, pp. 961–964.) Temperature-sensitive resistors and junction diodes are used in conjunction with compensating networks to eliminate drift effects. A two-stage amplifier circuit having a drift $<1\%$ in 106 hours at room temperature, is described.

621.375.5 : 621.319.4 **1368**

Building and Using Dielectric Amplifiers.—A. Silverstein. (*Electronics*, Feb. 1954, Vol. 27, No. 2, pp. 150–153.) A detailed account is given of the process developed at the National Bureau of Standards for preparing the (Ba-Sr)TiO_3 capacitors used in dielectric amplifiers. A two-stage voltage amplifier and an output stage capable of driving a loudspeaker are described.

621.396.822 + 537.311.3 **1369**

Low-Temperature Electronics.—C. A. Swenson & A. G. Emslie. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, pp. 408–413.) A survey is made of the temperature dependence of noise and resistance over a range of temperatures approaching absolute zero. Practical applications of the results of low-temperature research are discussed.

GENERAL PHYSICS

53 : 519.2 **1370**

On Statistical Estimation in Physics.—M. Annis, W. Cheston & H. Primakoff. (*Rev. mod. Phys.*, Oct. 1953, Vol. 25, No. 4, pp. 818–830.)

534.2 + 538.566 **1371**

Wave Propagation in Stratified Media at Normal Incidence, and Application to Transmission-Line Theory, Electric Waves, Optics, Acoustics, Wave Mechanics, and Mechanical and Electrical Quadripoles.—K. Altenburg & S. Kästner. (*Ann. Phys., Lpz.*, 20th Oct. 1953, Vol. 13, Nos. 1/5, pp. 1–43.) A comprehensive analysis with numerous references.

535.12 : 535.31 **1372**

Step-by-Step Transition from Wave Optics to Ray Optics in Inhomogeneous Anisotropic Absorbing Media: Part 2 — Solution of the Equations for Wave Normal and Refractive Index by WBK Approximation. Ray-Optical Reflection and Alternation.—K. Suchy. (*Ann. Phys., Lpz.*, 20th Oct. 1953, Vol. 13, Nos. 1/5, pp. 178–197.) The equations given in part 1 (2954 of 1953) are solved. The existence of particular points is established for which the transition cannot be made.

535.376 **1373**

The Mechanism of Electroluminescence: Part 1 — Theoretical Considerations.—D. Curie. (*J. Phys. Radium*, Oct. 1953, Vol. 14, No. 10, pp. 510–524.) An account based on Destriau's treatment, attributing the phenomena of electroluminescence to collisions of field-accelerated electrons in the conduction band. 35 references.

535.421 : 538.566 **1374**

Rigorous Analysis of the Diffraction of Electromagnetic Waves by Strip-Gratings.—R. Müller. (*Z. Naturf.*, Jan. 1953, Vol. 8a, No. 1, pp. 56–60.) A solution which is valid without restriction on wavelength, angle of incidence, polarization or grating constants is obtained in the form of two Fredholm integral equations of the first kind, of the same structure as those derived to represent diffraction by slotted diaphragms in rectangular waveguides (1583 of 1953).

537.122 **1375**

A Collective Description of Electron Interactions: Part 3 — Coulomb Interactions in a Degenerate Electron Gas.—D. Bohm & D. Pines. (*Phys. Rev.*, 1st Nov. 1953, Vol. 92, No. 3, pp. 609–625.) Part 2: 1021 of April.

537.122 **1376**

A Collective Description of Electron Interactions: Part 4 — Electron Interaction in Metals.—D. Pines. (*Phys. Rev.*, 1st Nov. 1953, Vol. 92, No. 3, pp. 626–636.) Part 3: 1375 above.

537.221 **1377**

Contact Electrification.—P. S. H. Henry. (*Sci. Progr.*, Oct. 1953, Vol. 41, No. 164, pp. 617–634.) The observed phenomena are described, and various explanatory hypotheses are discussed. Effects of 'static' and methods of eliminating them are indicated. 50 references.

537.52 **1378**

Some Measurements on a Not Selfsustaining Gas Discharge, with an Axial Magnetic Field.—J. Kistemaker & J. Snieder. (*Physica*, Oct. 1953, Vol. 19, No. 10, pp. 950–960.) Report of investigations of the potential distribution inside the central arc column of the discharge. The experimental arrangement consists of a cylindrical anode with a filamentary cathode at one end and a reflector at the other, and a hot probe. With electronegative gases deep troughs of negative potential are observed; with electropositive gases the central plasma potentials are still negative in relation to the anode.

537.521.7 **1379**

Ions and Barriers in Electric Discharges.—G. K. M. Pfestorf & R. S. N. Rau. (*J. Indian Inst. Sci.*, Section B, Oct. 1953, Vol. 35, No. 4, pp. 179–186.) Report of investigations on the effect of injecting ions into the spark gap, and of the effectiveness of paper screens in blocking the ions.

537.525 **1380**

A Condition on Uniform Field Breakdown in Electron-Attaching Gases.—R. Geballe & M. L. Reeves. (*Phys. Rev.*, 15th Nov. 1953, Vol. 92, No. 4, pp. 867–868.) The form of the curve relating E/p to p/d at breakdown (where E is the field strength, p the pressure and d the electrode separation) indicates the existence, for high values of pd, of a value of E/p below which breakdown does not occur. A study of the equation for steady-state current in electron-attaching gases suggests that this limiting value is nearly that for which the ionization and attachment coefficients are equal; this is confirmed experimentally.

537.525.001.11 **1381**

Development of the Theory of the Positive Column at Low Pressures: Part 1.—E. H. Ludwig. (*Z. angew. Phys.*, Oct. & Nov. 1953, Vol. 5, Nos. 10 & 11, pp. 377–386 & 421–426.)

537.533/.534 : [537.291 + 538.691 **1382**

Dioptrics of Electron and Ion Beams with Circular Principal Paths.—H. Grümm. (*Acta phys. austriaca*, Dec. 1953, Vol. 8, No. 2, pp. 119–140.)

537.533 : 537.534.9 **1383**

Secondary Emission due to Bombardment of Metallic Targets with Multiple-Charge Ions.—Yu. A. Dunaev & I. P. Flaks. (*C. R. Acad. Sci. U.R.S.S.*, 1st July 1953, Vol. 91, No. 1, pp. 43–45. In Russian.) An experimental investigation of the dependence of the coefficient of secondary emission on the energy of the ions. Sb, Bi, and Te targets were bombarded with Sb, Bi, and Te ions, respectively, and Ni targets with Na, Ba and Ca ions. The results are shown graphically.

537.533 : 538.691 **1384**

The Motion of Electrons in Two Combined Magnetic Fields.—S. G. Nilsson. (*Kungl. tek. Högsk. Handl., Stockholm*, 1953, No. 72, 22 pp. In English.) The focusing properties of the field of a homogeneously wound toroid have been investigated (383 of 1953). Analysis is now given for the case when this field is combined with a homogeneous field perpendicular to the plane of the toroid.

537.533 : 539.23 **1385**

Work Function of Clean and of Oxygen-Coated Au, Pt and Pd, based on the Contact-Potential Difference with respect to Ag.—J. Giner & E. Lange. (*Naturwissenschaften*, Oct. 1953, Vol. 40, No. 19, p. 506.) Values of the work function were found to be up to 1·2 V higher for the oxygen-coated than for the clean surfaces.

537.533.8 **1386**

Auger Peaks in the Energy Spectra of Secondary Electrons from Various Materials.—J. J. Lander. (*Phys. Rev.*, 15th Sept. 1953, Vol. 91, No. 6, pp. 1382–1387.) Measurements on C, Be, Al, Ni, Cu, Ba, Pt and oxides of some of these are reported; a description is given of the highly sensitive apparatus used. Characteristic peaks due to Auger electrons emitted as a result of absorption of a valence electron by an excited X-ray level were observed for all these materials. The structure exhibited by the peaks is related to the energy distribution of electrons in the valence band, and complements that observed in soft-X-ray emission. Excitation of Auger peaks by low-velocity electron beams provides a method of investigating surfaces.

537.56 **1387**

Generalized Ionization Formula for a Plasma.—G. Elwert. (*Z. Naturf.*, Nov. 1952, Vol. 7a, No. 11, pp. 703–708.) A formula is derived which includes as special cases Saha's equation, the gas-cloud ionization formula, and the solar-corona ionization equation.

538.12 **1388**

The Field along the Axes of Symmetry of Equal Semi-infinite Rectangular Magnetic Pole-Pieces.—W. Snowdon & N. Davy. (*Brit. J. appl. Phys.*, Nov. 1953, Vol. 4, No. 11, pp. 339–341.) The method of conformal representation is used. The field along the axes of symmetry is calculated for a number of values of the ratio of the width of the pole-pieces to the distance separating them. Expressions for the potential function are also given. See also 2152 of 1945 (Davy).

538.21 **1389**

Magnetic Behaviour of a Linear Atomic Chain at the Absolute Zero Point, for Positive Exchange Integral.—E. Ledinegg & P. Urban. (*Acta phys. austriaca*, Dec. 1953, Vol. 8, No. 2, pp. 167–174.) A calculation of the magnetic moment indicates that the linear atomic chain is not spontaneously magnetizable.

538.3 : 531.19 **1390**

On the Statistical Mechanics of Matter in an Electro-Magnetic Field: Part 1 — Derivation of the Maxwell Equations from Electron Theory.—P. Mazur & B. R. A. Nijboer. (*Physica*, Oct. 1953, Vol. 19, No. 10, pp. 971–986.) An ensemble-averaging method is used.

538.311 **1391**

Magnetic Field due to a Direct Current traversing a Solid Conductor of Arbitrary Shape. Application to a Cylindrical Conductor.—R. Cazenave. (*Rev. gén. Élect.*, Nov. 1953, Vol. 62, No. 11, pp. 536–542.) Laplace's law (usually known as Biot & Savart's law) is shown to be more suitable than Ampère's magnetic-sheet concept as a basis for deriving formulae for the magnetic field of a conductor. The vector potential is introduced.

538.561.029.6 **1392**

Cerenkov Effect at Microwave Frequencies.—M. Danos. S. Geschwind, H. Lashinsky & A. van Trier. (*Phys. Rev.*, 1st Nov. 1953, Vol. 92, No. 3, pp. 828–829.) Radiation of power $\simeq 10^{-7}$ W excited by a 10-kV, 0·2-mA beam, bunched at 24 kMc/s, and travelling close to the surface of a TiO_2 polycrystalline dielectric, has been detected.

539.162 : 537.212 : 533.15 **1393**

On the Diffusion of Decaying Particles in a Radial Electric Field.—J. Keilson. (*J. appl. Phys.*, Nov. 1953, Vol. 24, No. 11, pp. 1397–1400.) An analysis is made of the diffusion of charged particles in a radial field in which the intensity is distributed according to an inverse-square law.

548.0 : 539.15 **1394**

Electronic Polarizabilities of Ions in Crystals.—J. R. Tessman, A. H. Kahn & W. Shockley. (*Phys. Rev.*, 15th Nov. 1953, Vol. 92, No. 4, pp. 890–895.)

548.0 : 539.15 **1395**

Interaction of a Nonrelativistic Particle with a Scalar Field with Application to Slow Electrons in Polar Crystals.—T. D. Lee & D. Pines. (*Phys. Rev.*, 15th Nov. 1953, Vol. 92, No. 4, pp. 883–889.)

621.3.011.4 **1396**

Capacitance of a Spherical Capacitor.—F. Bertolini. (*Nuovo Cim.*, 1st Sept. 1952, Vol. 9, No. 9, pp. 852–854.) In a practical spherical capacitor, the capacitance is not given exactly by the theoretical formula, because the outer sphere has an aperture. Upper and lower limits are derived for the magnitude of the error involved.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.165 : 621.396.822 **1397**

Radio-Frequency Emission from Cosmic-Ray Electrons.—H. Siedentopf & G. Elwert. (*Z. Naturf.*, Jan. 1953, Vol. 8a, No. 1, pp. 20–23.) Theory developed by Schwinger (*Phys. Rev.*, 1949, Vol. 75, p. 1912) is used for the quantitative investigation of the intensity and spectral distribution of r.f. radiation from cosmic-ray electrons in interstellar magnetic fields. An upper limit is deduced for the density of an electron component of the cosmic radiation.

523.5 **1398**

The Strength of Meteoric Echoes from Dense Columns.—L. A. Manning. (*J. atmos. terr. Phys.*, Dec. 1953, Vol. 4, Nos. 4/5, pp. 219–225.) Calculations taking into account the refractive effects produced by ionization distributed at radii greater than the critical-density radius have been made for large highly ionized trails, using geometrical optics and ray-tracing methods. The computed maximum radiated power from a diffusion-formed trail is only 70% of that calculated on the critical-density radius method.

523.5 : 621.396.96 **1399**

Meteor Echo Duration and Radio Wavelength.—D. W. R. McKinley. (*Canad. J. Phys.*, Nov. 1953, Vol. 31, No. 7, pp. 1121–1135.) "The durations of radar echoes from meteors have been observed simultaneously on 9·22 m and 5·35 m, and also on 9·22 m and 2·83 m. The ratio of durations on two wavelengths decreases with increasing duration by a factor of two over the observed range, deviating significantly from the accepted square law of wavelengths. Plotting the log of the ratio against the log of the duration yields two straight lines of different slopes, one in the short-duration range and the other applying to the longer echoes. General empirical formulae are developed to predict the echo duration on one radio equipment in terms of the duration of the same echo recorded by another apparatus of different sensitivity and wavelength."

523.72 : 621.396.822 **1400**

Bailey's Theory of Sunspot Noise.—J. W. Dungey. (*J. atmos. terr. Phys.*, Dec. 1953, Vol. 4, Nos. 4/5, pp. 148–162.) A discussion of the exchange of energy between the drifting electrons and the wave radiated from a transient disturbance is given which is more general than Bailey's (1909 of 1950) and which shows that amplification can occur under certain conditions. Consideration of a sunspot model having axial symmetry leads to the conclusion that amplification will occur only in exceptional regions.

523.72 : 621.396.822 **1401**

The Equations for a Problem arising in Dungey's Investigation of Bailey's Theory of Sunspot Noise.—R. E. Loughhead. (*J. atmos. terr. Phys.*, Dec. 1953, Vol. 4, Nos. 4/5, pp. 163–174.) See 1400 above.

523.746 **1402**

The Magnetic Field Strength in Sunspots.—W. Mattig. (*Naturwissenschaften*, Oct. 1953, Vol. 40, No. 20, p. 523.) Reply to Thiessen's criticism (2303 of 1953).

523.746 : 621.396.822 **1403**

Theories of Solar Phenomena depending on Sunspot Fields moving in the Chromosphere and Corona.—J. H. Piddington. (*Mon. Not. R. astr. Soc.*, Oct. 1953, Vol. 113, No. 2, pp. 188–197.) Theories advanced by Giovanelli (78 and 376 of 1949) and various other workers are found to be untenable when mechanical reactions between the magnetic fields and the conducting gas are taken into account.

523.75 : 538.6 **1404**

A Family of Solutions of the Magneto-hydrostatic Problem in a Conducting Atmosphere in a Gravitational Field.—J. W. Dungey. (*Mon. Not. R. astr. Soc.*, Oct. 1953, Vol. 113, No. 2, pp. 180–187.) A theoretical study of the equilibrium conditions in a quiescent solar prominence. A simple model is obtained.

523.75 : [550.386 + 551.510.535] **1405**

Ionospheric and Geomagnetic Effects of Solar Flares.—J. W. Beagley. (*N.Z. J. Sci. Tech. B*, Sept. 1953, Vol. 35, No. 2, pp. 141–151.) Geomagnetic crochets observed at Amberley and Apia, New Zealand, between 1947 and 1951, simultaneously with Dellinger fadeouts, are considered in relation to subsequent magnetic and ionospheric disturbances. Their hourly and seasonal frequencies are examined and their augmentation of the normal diurnal inequality verified.

523.75 : 551.510.535 **1406**

The $H\alpha$ Radiation from Solar Flares in relation to Sudden Enhancements of Atmospherics on Frequencies near 27 kc/s.—M. A. Ellison. (*J. atmos. terr. Phys.*, Dec. 1953, Vol. 4, Nos. 4/5, pp. 226–239.)

523.8 : 621.396.822 **1407**

Radio Astronomy: Part 2 — Results of Observations of Cosmic Radio-Noise Sources.—H. Siedentopf. (*Arch. elekt. Übertragung*, Nov. 1953, Vol. 7, No. 11, pp. 507–517.) A survey with 46 references. Part 1: 390 of February (Dieminger).

523.81 : 621.396.822 **1408**

A Survey of 23 Localized Radio Sources in the Northern Hemisphere.—R. H. Brown & C. Hazard. (*Mon. Not. R. astr. Soc.*, Oct. 1953, Vol. 113, No. 2, pp. 123–133.) Report of a survey at a wavelength of 1·89 m, made with the Jodrell Bank aerial system. A marked concentration of the intense sources near the galactic plane was found; the distribution of the weaker sources may be more nearly isotropic.

523.85 : 621.396.822 **1409**

A Radio Survey of the Milky Way in Cygnus, Cassiopeia and Perseus.—R. H. Brown & C. Hazard. (*Mon.*

Not. R. astr. Soc., Oct. 1953, Vol. 113, No. 2, pp. 109–122.) Report of a survey at a frequency of 158·5 Mc/s, using the Jodrell Bank 2°-beam aerial, and covering the region between $l = 40°$ and $l = 130°$ and between $b = 14°$ and $b = -14°$. The isophotes of the absolute intensities are shown.

523.852.3 : 621.396.822 **1410**

Fine Structure of the Extraterrestial Radio Source Cygnus I.—R. C. Jennison & M. K. Das Gupta. (*Nature, Lond.*, 28th Nov. 1953, Vol. 172, No. 4387, pp. 996–997.) Observations made at Jodrell Bank are reported.

523.854 : 621.396.822 **1411**

Radio Astronomy.—H. H. Klinger. (*J. Franklin Inst.*, Oct. 1953, Vol. 256, No. 4, pp. 353–366.) A survey paper. See 126 of January.

550.37 : 550.384 **1412**

The Relation between Earth Currents and Geomagnetic Variations.—A. P. Bondarenko. (*C. R. Acad. Sci. U.R.S.S.*, 21st March 1953, Vol. 89, No. 3, pp. 443–445. In Russian.) A comparison was made between the time variations of $curl_z\ E$ and H'_z, where E is the electric field and H'_z is the resultant vertical component of the geomagnetic variations. Fair agreement between the curves was obtained.

550.384.4 **1413**

Rapid Periodic Fluctuations of the Geomagnetic Field: Part 1.—E. R. R. Holmberg. (*Mon. Not. R. astr. Soc., geophys. Supplement*, Oct. 1953, Vol. 6, No. 8, pp. 467–481.) A new analysis is made of observational data, mainly from Eskdalemuir. The type of fluctuation changes at sunset from a continuous flux of disturbance to a comparative quiet punctuated by a short damped wave train. A definite fine structure is observed in the spectrum of the daytime fluctuations.

551.510.535 **1414**

The Analysis of Ionospheric Records (Ordinary Ray): Part 1.—D. H. Shinn. (*J. atmos. terr. Phys.*, Dec. 1953, Vol. 4, Nos. 4/5, pp. 240–254.) Tables presented enable the effect of the earth's magnetic field to be taken into account when using the method of analysis of Ratcliffe (1292 of 1952) or of Appleton & Beynon (3290 of 1940). Using these tables, theoretical $h'f$ curves can be constructed for a parabolic or a linear distribution of ionization and for all magnetic latitudes up to about 70°.

551.510.535 **1415**

Variations of D-Layer Attenuation at 245 kc/s.—E. A. Lauter. (*Z. Met.*, Nov. 1953, Vol. 7, No. 11, pp. 321–330.) Results of daytime reflection-coefficient measurements made over a period of several years are analysed. The noon value of the attenuation is 2 neper in winter, nearly 7 neper in summer. Though the scatter of values is considerably greater in winter than in summer, the excessive absorption observed in winter on short waves is not observed at this frequency. The influence of the D layer on the propagation of atmospherics is discussed, and the attenuation variations are compared with those of geomagnetic activity.

551.510.535 **1416**

The Contribution of Solar X-Rays to E-Layer Ionization.—E. T. Byram, T. A. Chubb & H. Friedman. (*Phys. Rev.*, 15th Nov. 1953, Vol. 92, No. 4, pp. 1066–1067.) A brief description of rocket experiments which provide positive evidence of soft X-rays in the ionosphere, to an extent sufficient to account for all the E-layer ionization.

551.510.535 **1417**

Electric Currents in the Ionosphere: Part 1 — The Conductivity.—W. G. Baker & D. F. Martyn. (*Phil. Trans. A*, 16th Dec. 1953, Vol. 246, No. 913, pp. 281–294.) The effective height-integrated conductivity of the ionosphere, calculated on the dynamo theory, and taking account of inhibition of the Hall current due to polarization of the medium, is greater than the Pedersen conductivity by a factor of at least 6, and, near the magnetic equator, is further increased by a factor of 2 to 5. This calculation is shown to overestimate the reduction in total current flow in the ionosphere due to the 'shunting' effect of the F_2 region, when the motion of the F_2 region is considered. The dynamo theory, as presented here, gives results in agreement with observations, and accounts in particular for the anomalously large magnetic variations observed near the equator.

551.510.535 **1418**

Electric Currents in the Ionosphere: Part 2 — The Atmospheric Dynamo.—W. G. Baker. (*Phil. Trans. A*, 16th Dec. 1953, Vol. 246, No. 913, pp. 295–305.) Assuming semidiurnal tidal air flow, the atmospheric dynamo problem is solved, the ionosphere being divided into three regions, each of appropriate conductivity. Compared with calculations assuming Pedersen conductivity alone effective, results give a current system similar in shape and phase, though more intense, and an electric field system markedly different. An abnormally large east-west current is found at the equator.

551.510.535 **1419**

Electric Currents in the Ionosphere: Part 3 — Ionization Drift due to Winds and Electric Fields.—D. F. Martyn. (*Phil. Trans. A*, 16th Dec. 1953, Vol. 246, No. 913, pp. 306–320.) The motion of a cylinder of ionization, of density differing from that of the surrounding medium, tends to be such that the ionization density is greatly increased over part of its surface and diminished over another part. The significance of this result in relation to sporadic-E ionization and to long-duration meteor trails is pointed out. Formulae are derived for the horizontal and vertical drift of ionization at all atitudes. Graphs are given which permit derivation of the true wind or field in a given ionosphere region from experimental observations of the drift velocities.

551.510.535 **1420**

Semidiurnal Currents and Electron Drifts in the Ionosphere.—J. A. Fejer. (*J. atmos. terr. Phys.*, Dec. 1953, Vol. 4, Nos. 4/5, pp. 184–203.) The differential equations of the dynamo theory for the ionosphere are solved numerically under simplifying assumptions. The tidal amplification estimated is about 60. For the solar tide, the current system in the E layer is in phase with the ground tide, but for the lunar tide it is in phase opposition. The calculated vertical electron drift is in reasonable agreement with lunar tide observations. The calculated horizontal electron drift agrees with observations on long-duration meteor-trail echoes, but the calculated phases are opposed to those obtained from fading measurements, indicating that the latter refer to air movements and not to electron drift.

551.510.535 **1421**

Solar Tides in the F_2 Region from the Study of Night-Time Critical Frequencies.—A. A. Weiss. (*J. atmos. terr. Phys.*, Dec. 1953, Vol. 4, Nos. 4/5, pp. 175–183.) "Night-time critical frequency variations at 25 ionospheric stations are analysed by season and by latitude for semi-diurnal solar tidal terms. The amplitude and phase of the vertical drift velocity of electrons so found are consistent with accepted tidal theory, and an estimate of the height-gradient of the vertical drift is obtained.

Two parallel analyses are made, on the alternative assumptions that decay proceeds according to a recombination law or to an attachment law. The low values found for the decay coefficients preclude any decision as to which of these two decay processes is actually operative."

551.510.535 : 523.78 **1422**

Anomalies of the Ionosphere [F_2-layer] **Critical Frequencies during a Solar Eclipse.**—G. Zanotelli. (*Ann. Geofis.*, July 1953, Vol. 6, No. 3, pp. 367–372.) Soundings made at Rome during the partial eclipse of 25th February 1952 are reported. Electron-concentration minima were observed before and after the eclipse and at the maximum phase. The cause of the first and last of these maxima is assumed to reside in the zone outside the visible disk of the sun.

551.510.535 : 550.385 **1423**

Determination of the Location of the Ionospheric Current System responsible for Geomagnetic Effects of Solar Flares.—A. P. Mitra & R. E. Jones. (*J. atmos. terr. Phys.*, Dec. 1953, Vol. 4, Nos. 4/5, pp. 141–147.) The height of the flare current system is calculated by a method depending on the time of maximum intensity of a geomagnetic flare effect and the enhancement of electron density at the relevant level. If the flare current system forms part of the Sq current system, its height is 100–120 km, but if it is independent, its height is about 60 km.

551.510.535 : 551.55 : 523.5 **1424**

Measurements of Winds in the Upper Atmosphere by means of Drifting Meteor Trails: Part 1.—D. S. Robertson, D. T. Liddy & W. G. Elford. (*J. atmos. terr. Phys.*, Dec. 1953, Vol. 4, Nos. 4/5, pp. 255–270.) Description of the 27-Mc/s doppler-radar system and the associated equipment.

551.510.535 : 551.55 : 523.5 **1425**

Measurements of Winds in the Upper Atmosphere by means of Drifting Meteor Trails: Part 2.—W. G. Elford & D. S. Robertson. (*J. atmos. terr. Phys.*, Dec. 1953, Vol. 4, Nos. 4/5, pp. 271–284.) Results of measurements made during Oct.–Dec. 1952 by the method described in 1424 above are discussed. Winds at heights between 80 and 105 km are, in general, horizontal, with a prevailing direction in October towards the north-east, and in November and December towards the east. The 12-hour and 24-hour harmonic components represent anti-clockwise rotation of the wind vectors, the 12-hour component being consistent with the phase of a semi-diurnal tidal wind as deduced from barometric oscillations. Over the height range investigated, the direction of the wind remains the same but the mean velocity increases with height.

551.510.535 : [621.396.822 : 523.8 **1426**

The Measurement of Ionospheric Absorption using Observations of 18·3-Mc/s Cosmic Radio Noise.—A. P. Mitra & C. A. Shain. (*J. atmos. terr. Phys.*, Dec. 1953, Vol. 4, Nos. 4/5, pp. 204–218.) Ionospheric absorption is specified by the ratio, expressed in decibels, of P, the received cosmic noise power, to P_0, the power that would have been received in the absence of absorption. From about a year's observations of cosmic noise, a standard curve of P_0/ sidereal time can be drawn for all aerial directions. Analysis of records made at Hornsby, N.S.W., from June 1950 to June 1951, shows that two main components due to absorption in the F_2 and D regions respectively can be distinguished.

551.594.6 **1427**

The Waveforms of Atmospherics.—M. W. Chiplonkar. (*Endeavour*, Oct. 1953, Vol. 12, No. 48, pp. 190–196.) A review of research during the preceding fifty years on lightning and on atmospherics, showing the relation between the two phenomena. 28 references.

551.594.6 : 538.566 **1428**

Harmonic Fields in the Propagation of Long Electric Waves round the Earth, and Lightning Waveforms.—Schumann. (See 1544.)

551.594.6 : 538.566 **1429**

The Propagation of Very Long Electric Waves round the Earth, and Atmospherics.—Schumann. (See 1545.)

LOCATION AND AIDS TO NAVIGATION

534.87/.88 + 534.614 **1430**

The Development of Acoustic Sea-Depth Measurements.—H. Drubba & H. H. Rust. (*Z. angew. Phys.*, Oct. 1953, Vol. 5, No. 10, pp. 388–400.) A historical survey of methods used in measurements of the velocity of sound in water and in sound ranging, from 1826 to date. 104 references.

621.396.933 **1431**

Raydist Systems for Radiolocation and Tracking.—J. M. Benson & J. E. Swafford. (*Elect. Engng, N.Y.*, Nov. 1953, Vol. 72, No. 11, pp. 983–987.) Phase-measurement methods making use of the heterodyne signal between c.w. transmitters obviate the need for phase-locking the transmitters or for very high accuracy of frequency control. Several particular arrangements are described.

621.396.96 **1432**

The Story of Radar.—A. F. Wilkins. (*Research, Lond.*, Nov. 1953, Vol. 6, No. 11, pp. 434–440.) An account of the main points in the development of radar in Britain, from 1935 onwards.

621.396.96 **1433**

How Long-Line Effect impairs Tunable Radar.—J. F. Hull, G. Novick & R. Cordray. (*Electronics*, Feb. 1954, Vol. 27, No. 2, pp. 168–173.) The conditions are analysed under which long mismatched output lines cause frequency jumping in magnetrons and other valve oscillators. Design data are given for eliminating the gaps in the tuning range which occur when the r.f. generator cannot be mounted directly on the aerial.

621.396.962.2 : 621.376.3] : 629.13 **1434**

Improved Radio Altimeter.—A. Bloch, K. E. Buecks & A. G. Heaton. (*Wireless World*, March 1954, Vol. 60, No. 3, pp. 138–140.) The instrument uses a transmission frequency varying linearly between 1.605 and 1.655 kMc/s, the reflected wave being heterodyned with an oscillation always 110 Mc/s higher than the transmitted wave. The parameters are chosen so that a beat frequency of 10 kc/s is produced at a height of 900 ft, a servomechanism being used to limit the beat frequency to this value at greater altitudes, so as to avoid the need for a wide-band amplifier, and the consequent increase of noise.

621.396.969 **1435**

The Harbour Radar System for Rotterdam and the New Waterway.—N. Schimmel. (*Tijdschr. ned. Radiogenoot.*, Nov. 1953, Vol. 18, Nos. 5/6, pp. 301–311.) Equipment under construction is discussed; the transmitter frequency range is to be 8·9–9·2 kMc/s, and the peak power at least 10 kW. The operational procedure and methods of measurement are outlined. The system should be completed by 1955.

621.396.969.33 **1436**

Marine Radar.—(*Overseas Engr*, Oct. 1953, Vol. 27, No. 310, pp. 97–101.) Brief illustrated descriptions and some performance figures are given for British equipment for installation on board ship.

MATERIALS AND SUBSIDIARY TECHNIQUES

535.37 : 535.215.1 **1437**

The Photoconductivity of Phosphors with Different Luminescence Mechanisms.—H. Gobrecht, D. Hahn & H. J. Kösel. (*Z. Phys.*, 16th Oct. 1953, Vol. 136, No. 1, pp. 57–66.) Measured photoelectric currents (down to 10^{-14} A) of 49 powder phosphor preparations are listed. These indicate the correspondence of high and low values of photoconductivity respectively with bimolecular and unimolecular luminescence mechanisms.

535.37 : 546.472.21 **1438**

The Connection between Darkening and Luminescence of Zinc Sulphide.—H. Gobrecht & W. Kunz. (*Z. Phys.*, 16th Oct. 1953, Vol. 136, No. 1, pp. 21–25.) The phenomenon of darkening due to irradiation by light is investigated.

535.37 : 548.55 **1439**

On Growing Single Crystals of Thallium-Activated Alkali Halides.—J. Franks. (*Brit. J. appl. Phys.*, Dec. 1953, Vol. 4, No. 12, pp. 377–378.) A description is given of a suitable furnace. Activated iodide crystals gave very intense luminescence under electron bombardment.

535.37 : 621.317.373 **1440**

Measurement of Luminescence Decay Time by means of the Phase [-detector] **Valve.**—Rohde. (See 1504.)

535.372 : 546.284$_o$ **1441**

A New 6 100-Å Band in Zinc Orthosilicate activated with Manganese.—P. Zalm & H. A. Klasens. (*Philips Res. Rep.*, Oct. 1953, Vol. 8, No. 5, pp. 386–392.) Activation in the presence of ammonium phosphate at low temperatures gives the additional band, the properties of which are discussed.

535.376 **1442**

The Light Yield of Phosphors excited by Electron Beams with Accelerating Voltages of 5–60 kV.—H. Arend & H. Irmler. (*Naturwissenschaften*, Nov. 1953, Vol. 40, No. 22, pp. 577–578.) Measurements were made of the light emitted in both forward and backward directions. The relation between the light yield and the accelerating voltage for constant beam current is shown graphically for phosphors of various compositions and grain sizes. The shape of the curves depends on the direction of observation. The divergence between the theoretical and actual light yield is discussed; the actual yield is independent of layer thickness as long as the latter is greater than the electron penetration depth.

537.224 **1443**

Electrets.—G. G. Wiseman & E. G. Linden. (*Elect. Engng, N.Y.*, Oct. 1953, Vol. 72, No. 10, pp. 869–872.) A survey and nonmathematical discussion of electret materials, theories and applications. Tables are given of reported electrets of 5 pure substances and of 20 substances showing only a decaying charge and 17 giving a charge reversal or growth of charge. The applications noted include microphones, radiation dosimeters, electrometers and an e.s. vibration voltmeter.

537.226 **1444**

Characteristics of Ferroelectric Ceramics near the Curie Point.—N. P. Bogoroditski & T. N. Verbitskaya. (*C. R. Acad. Sci. U.R.S.S.*, 21st March 1953, Vol. 89, No. 3, pp. 447–449. In Russian.) Report of an investigation of ferroelectric materials with Curie points near 120°C, 35°C and 150°C, respectively. Graphs show the variation with time (in months) of the capacitance and of the loss-tangent of ferroelectric capacitors and the effect of aging on the capacitance/electric-field-strength characteristic. The results are discussed in relation to the orientation of the domains and the change in the electric moment.

537.226 : 546.321.85 **1445**

The Properties of Colloidal Ferroelectric Materials: Part 2 — Theoretical Considerations.—W. Känzig & R. Sommerhalder. (*Helv. phys. Acta*, 16th Nov. 1953, Vol. 26, No. 6, pp. 603–610. In German.) The spontaneous-polarization effects described by Jaccard et al. (776 of March) can be explained by introducing the energy of the depolarizing field and the energy of the domain walls into the free energy of the crystal given by Mueller's theory (109 of 1941). The interaction of a polarized ferroelectric crystal with its depolarizing field is discussed. The wall problem is also considered.

537.226 : 546.431.824-31 : 546.817.831.4 **1446**

Ferroelectric Properties of $BaTiO_3$-$PbZrO_3$ Solid Solutions.—G. A. Smolenski, A. I. Agranovskaya & N. N. Krainik. (*C. R. Acad. Sci. U.R.S.S.*, 1st July 1953, Vol. 91, No. 1, pp. 55–58. In Russian.) Experimental determination of the temperature dependence of the permittivity, in weak fields, and of $\Delta l/l$, where l is the length of the specimen. These results and the derived variation of the Curie point with $PbZrO_3$ concentration are shown graphically.

537.226 : 546.817.824 **1447**

Domain Structure of Lead Titanate.—E. G. Fesenko. (*C. R. Acad. Sci. U.R.S.S.*, 11th Feb. 1953, Vol. 88, No. 5, pp. 785–786. In Russian.) The phase transition near 500°C was investigated by an optical method. Photographs of a twinned crystal show the permanent structural change on heating above 500°C.

537.226 : 546.817.882.5-33 **1448**

Ferroelectric Properties of Lead Metaniobate.—G. Goodman. (*J. Amer. ceram. Soc.*, Nov. 1953, Vol. 36, No. 11, pp. 368–372.) "Ferroelectric lead metaniobate, $Pb(NbO_3)_2$, is structurally distinct from the ABO_3 perovskite-type ferroelectrics presently known. Dielectric and dilatometric data indicate a 570°C Curie point. In ceramic form the material can be polarized to retain a piezoelectric constant of the same order of magnitude as that of barium titanate."

537.226 : 621.315.612.4 **1449**

Dielectrics containing Barium Titanate.—W. Soyck. (*Schweiz. Arch. angew. Wiss. Tech.*, Oct. 1953, Vol. 19, No. 10, pp. 316–322.) A short review; aspects discussed include the ceramic structure and electrical properties of $BaTiO_3$, ageing, effect of nonuniform fields and of high temperatures and field strengths, and behaviour at high frequency.

537.311.3 **1450**

The Resistance of 72 Elements, Alloys and Compounds to 100 000 kg/cm^2.—P. W. Bridgman. (*Proc. Amer. Acad. Arts Sci.*, March 1952, Vol. 81, No. 4, pp. 165–251.)

537.311.33 **1451**

On Conduction in Impurity Bands.—W. Baltensperger. (*Phil. Mag.*, Dec. 1953, Vol. 44, No. 359, pp. 1355–1363.) "The idea of conduction by electrons in the energy bands of an impurity system is examined. For a lattice of

hydrogen-like impurities the edges of the 1s, 2s, and 2p bands are calculated. Effective masses for electrons in these bands are introduced. With their help measurements of the conductivity and the Hall constant are interpreted. Depending on the density of the impurities and on the temperature, conduction takes place predominantly either in the band of the medium, or in excited impurity states, or in the 1s impurity band. In this last case the activation energy vanishes. This interpretation implies a description of the electronic state of the impurities with band wave functions and indicates the validity of such a description up to rather large values of the lattice constant. This can however be reconciled with the insulating properties of the oxides of transition metals."

537.311.33 **1452**

Modification of the Conductivity of Thin Semiconductor Films by Capacitively Applied Barrier-Layer Fields.—K. Zückler. (*Z. Phys.*, 16th Oct. 1953, Vol. 136, No. 1, pp. 40–51.) The principle used by Shockley & Pearson (3438 of 1948) was applied to determine barrier-layer properties for Se and Cu_2O. An evaporated semiconductor film formed one electrode of a mica capacitor. The variation of the resistance of the semiconductor with the voltage applied across the capacitor was measured at $-78°$, $+25°$ and $+80°$C by means of an auxiliary circuit. Values for the thickness of the barrier layer, the concentration of impurity centres and the mobility of charge carriers in the semiconductor are calculated assuming exhaustion of impurity centres (*a*) across the whole film, (*b*) within the barrier layer only.

537.311.33 **1453**

Apparatus for the Graphical Determination of the Fermi Energy Level in Semiconductors.—E. Mooser. (*Z. angew. Math. Phys.*, 15th Nov. 1953, Vol. 4, No. 6, pp. 433–449.) A method of determining the Fermi energy from the temperature and band-structure parameters is described in detail, with examples. The method also gives the temperature dependence of the concentration of charge carriers, taking account of degeneracy.

537.311.33 **1454**

New Semiconducting Compounds.—H. Welker. (*Z. Naturf.*, Nov. 1952, Vol. 7a, No. 11, pp. 744–749.) An investigation of compounds formed from Al, Ga or In on the one hand and P, As or Sb on the other. Such semiconducting compounds may have properties greatly superior to those of diamond, Si, Ge or grey tin. Electron mobilities up to 25 000 cm/s per V/cm have been measured in InSb.

537.311.33 **1455**

A Simple Demonstration Model of a *p-n* Junction.—W. Heywang. (*Naturwissenschaften*, Oct. 1953, Vol. 40, No. 20, pp. 527–528.)

537.311.33 : 535.215 **1456**

Quantum-Statistical Treatment of the Internal Photoeffect.—H. Müser. (*Z. Naturf.*, Nov. 1952, Vol. 7a, No. 11, pp. 729–734.) The distribution of electrons between possible energy levels is investigated for the case where a given number of electrons per second is shifted from a lower to a higher level.

537.311.33 : 537.312.6 **1457**

Rectification in Semiconductors in a Thermal Field.—I. M. Tsidil'kovski. (*C. R. Acad. Sci. U.R.S.S.*, 1st July 1953, Vol. 91, No. 1, pp. 63–66. In Russian.) Theoretical investigation of rectification by a system comprising a semiconductor layer between a pair of metal electrodes between which a potential difference and a temperature difference exist. Semiconductors considered are Cu_2O, Ge and Si. The calculated and the experimentally determined relations between K (ratio of backward to forward resistance) and V (potential difference) are shown graphically for a semiconductor with specified constants.

537.311.33 : 537.312.62 **1458**

Superconductivity of Impurity Semiconductors (PbS).—E. Justi & H. Schultz. (*Z. Naturf.*, Feb./March 1953, Vol. 8a, Nos. 2/3, pp. 149–155.) Measurements on evaporated films of controlled composition are reported. Superconductivity is not observed with films containing an excess of S or a small excess of Pb, but is observed with a large excess of Pb, the resistivity dropping sharply below 7·26°K. These results are discussed in relation to the possible mechanisms involved.

537.311.33 : 546.18-171 **1459**

The Electrical Properties of Black Phosphorus.—R. W. Keyes. (*Phys. Rev.*, 1st Nov. 1953, Vol. 92, No. 3, pp. 580–584.) Electrical conductivity and Hall constant were determined over the temperature range $-195°$C to 350°C. The conductivity at pressures up to 8 000 kg/cm², magnetoresistance coefficients at $-195°$C and $-80°$C and infrared absorption between 2 μ and 30 μ were also determined. At low temperatures p-type impurity conduction was observed; at high temperatures the phosphorus is an intrinsic semiconductor with an energy gap of 0·33 eV.

537.311.33 : [546.28 + 546.289 **1460**

Production of Acceptor Centers in Germanium and Silicon by Plastic Deformation.—W. C. Ellis & E. S. Greiner. (*Phys. Rev.*, 15th Nov. 1953, Vol. 92, No. 4, pp. 1061–1062.) Ge crystals have been converted from n to p type by compression at high temperature; the accompanying changes of resistivity correspond to the introduction of 10^{15} acceptor centres/cm³. Similar results were obtained with Si at greater compression and higher temperature.

537.311.33 : 546.289 **1461**

On the Effective Mass of the Conduction Electron in Germanium.—W. Sasaki & M. Kuno. (*J. phys. Soc. Japan*, Nov./Dec. 1953, Vol. 8, No. 6, pp. 791–792.) Determinations based on Hall-effect and thermoelectric measurements on n-type single crystals are tabulated and compared with results obtained by Debye & Conwell (425 of 1953).

537.311.33 : 546.289 **1462**

Drift Mobilities in Semiconductors: Part 1 — Germanium.—M. B. Prince. (*Phys. Rev.*, 1st Nov. 1953, Vol. 92, No. 3, pp. 681–687.) The drift mobilities μ_p and μ_n of holes in n-type and of electrons in p-type material respectively were determined over the temperature range 150°–350°K for samples with a range of resistivities from 0·05 to 30 Ω.cm at 300°K. For single crystals of resistivity > 10 Ω.cm the relations between mobility and temperature are given by $\mu_n = 3{\cdot}5 \times 10^7 T^{-1.6}$ and $\mu_p = 9{\cdot}1 \times 10^8 T^{-2.3}$. The relation between resistivity and concentration of impurity centres is shown graphically.

537.311.33 : 546.289 **1463**

Solubility and Ionizability of Impurities in Germanium Single Crystals.—W. Dürr, J. Jaumann & K. Seiler. (*Z. Naturf.*, Jan. 1953, Vol. 8a, No. 1, pp. 39–46.) Rod-shaped single crystals were grown from a melt of pure Ge with controlled additions of Ga, As or Sb. Measurements were made of the variation of Hall constant and conductivity along the direction of growth, and of the temperature dependence of these constants. The actual impurity content of a homogeneous middle portion of the crystal is

determined by remelting and recrystallizing and comparing the constants with curves prepared for crystals from melts with known impurity concentrations. The results indicate that every donor atom (within ± 30%) yields one charge carrier, i.e., the ionizability has the value unity.

537.311.33 : 546.289 **1464**

A Method of estimating Impurity Concentrations in Germanium.—F. W. G. Rose & E. W. Timmins. (*Proc. phys. Soc.*, 1st Nov. 1953, Vol. 66, No. 407B, pp. 984–986.) Families of theoretical curves of log resistivity against inverse temperature for different values of impurity concentration were prepared corresponding to two sets of assumptions, namely (*a*) carrier and impurity concentrations equal, lattice scattering predominant, and (*b*) carrier and impurity concentrations unequal, both lattice and impurity scattering significant. The impurity content of a specimen is estimated by selecting the theoretical curve which best fits the experimental curve.

537.311.33 : 546.289 **1465**

Some Consequences of Possible Degeneracy of Energy Bands in Ge.—E. N. Adams, II. (*Phys. Rev.*, 15th Nov. 1953, Vol. 92, No. 4, pp. 1063–1064.) Critical examination of theory developed by Herman & Callaway (1699 of 1953).

537.311.33 : 546.289 **1466**

Further Measurements of the Effect of Pressure on the Electrical Resistance of Germanium.—P. W. Bridgman. (*Proc. Amer. Acad. Arts Sci.*, April 1953, Vol. 82, No. 2, pp. 71–82.) For reports of previous measurements see 1450 above and 2439 of 1951.

537.311.33 : 546.289 : 538.224 **1467**

The Magnetic Susceptibility of Germanium.—D. K. Stevens & J. H. Crawford, Jr. (*Phys. Rev.*, 15th Nov. 1953, Vol. 92, No. 4, pp. 1065–1066.) Measurements have been made on both *p*- and *n*-type specimens over the temperature range 65°–300°K. Some results are shown graphically and used to estimate the ratio of free-electron mass to effective carrier mass.

537.311.33 : 546.289 : 538.569.4.029.6 **1468**

Observation of Cyclotron Resonance in Germanium Crystals.—G. Dresselhaus, A. F. Kip & C. Kittel. (*Phys. Rev.*, 1st Nov. 1953, Vol. 92, No. 3, p. 827.) Diamagnetic resonance has been observed at 4°K in 38-Ω.cm *n*-type Ge at a field strength of 370 ± 5 oersted, and in *p*-type Ge at 125 ± 5 and at 970 ± 50 oersted, at a frequency of 9·05 kMc/s.

537.311.33 : 546.289 : 548.4.021 **1469**

Annealing of Bombardment Damage in Germanium: Experimental.—W. L. Brown, R. C. Fletcher & K. A. Wright. (*Phys. Rev.*, 1st Nov. 1953, Vol. 92, No. 3, pp. 591–596.) The damage produced by 3-MeV electrons, consisting primarily in the production of isolated vacancy-interstitial pairs, was determined by conductivity measurements on *n*-type samples. The activation energy for the diffusion of vacancies is found to be ~ 1·7 eV. The annealing curves are compared with curves derived from the theoretical model discussed by Fletcher & Brown (1477 below).

537.311.33 : 546.289 : 620.185 **1470**

New Etches for Germanium.—R. C. Ellis, Jr, & S. P. Wolsky. (*J. appl. Phys.*, Nov. 1953, Vol. 24, No. 11, pp. 1411–1412.) Preliminary report of an investigation of etching solutions other than hydrofluoric acid.

537.311.33 : 546.3-1-46-289-811 **1471**

Electrical Conductivity of Mixed Crystals of Intermetallic Compounds.—G. Busch & U. Winkler. (*Helv. phys. Acta*, 16th Nov. 1953, Vol. 26, No. 6, pp. 578–583. In German.) The lattice constant, activation energy and variation of conductivity with temperature were determined experimentally for twelve different $Mg_2(Ge_x Sn_{1-x})$ compounds. The results are shown graphically and tabulated.

537.311.33 + 535.215.1] : 546.36.863 **1472**

Studies on the Cs_3Sb Photo-Cathode.—T. Sakata. (*J. phys. Soc. Japan*, Nov./Dec. 1953, Vol. 8, No. 6, pp. 723–730.) Determinations of spectral and energy distributions indicate that Cs_3Sb is a semiconductor with values of δ about 0·2–0·3 eV, where δ is the difference between the Fermi level and the top of the occupied energy band. The value of the work function found by the photoelectric method was about 1·8 ± 0·1 eV.

537.311.33 + 535.215.1] : 546.36.863 : 538.632 **1473**

The Hall Effect in Cs_3Sb Photo-Cathode.—T. Sakata. (*J. phys. Soc. Japan*, Nov./Dec. 1953, Vol. 8, No. 6, pp. 793–795.) Results of measurements at a frequency of 800 c/s confirm that Cs_3Sb is a *p*-type semiconductor.

537.311.33 : 546.482.21 **1474**

Production of a *P*-Type CdS Rectifier by High Local Heating of *N*-Type Crystals.—G. Strull. (*J. appl. Phys.*, Nov. 1953, Vol. 24, No. 11, p. 1411.) Experimental evidence is given of *n*-type CdS crystals changing to *p*-type on application of intense local heating.

537.311.33 : 546.811-17 **1475**

Investigation of the Mechanism of Electrical Conduction in Grey Tin.—G. Busch & J. Wieland. (*Helv. phys. Acta*, 15th Dec. 1953, Vol. 26, Nos. 7/8, pp. 697–730. In German.) Results of earlier measurements of conductivity, Hall effect and variation of resistivity with applied magnetic field [2438 of 1951 (Busch et al.)] are discussed in detail in the light of present theory of semiconductors. Calculated values for charge-carrier concentrations and mobilities are considered in relation to different scattering processes, and the effects of added impurities and of incomplete transition are assessed. By means of a suitable model the absolute conductivity can be determined. At the transition point it is $2{\cdot}7 \times 10^3 \Omega^{-1}.cm^{-1}$, about one fortieth of that for the metallic modification.

537.311.33 : 546.811-17 : 538.22 **1476**

The Magnetic Properties of Semiconductors, with Particular Reference to Grey Tin.—G. Busch & E. Mooser. (*Helv. phys. Acta*, 16th Nov. 1953, Vol. 26, No. 6, pp. 611–656. In German.) The electrons and holes in a semiconductor are divided into three groups: (*a*) electrons in the valency band and in lower energy states, (*b*) free charge-carriers, i.e. electrons in the conduction band and holes in the valency band, and (*c*) electrons and holes which occupy the impurity levels and impurity bands between the conduction and the valency band. The susceptibilities corresponding to these groups are, respectively, the 'atom-susceptibility', the 'charge-carrier susceptibility' and the 'impurity-centre susceptibility'. These are discussed from the theoretical point of view and the results are used to interpret the susceptibility measurements made on grey tin with and without added impurities.

537.311.33 : 548.4.021 **1477**

Annealing of Bombardment Damage in a Diamond-Type Lattice: Theoretical.—R. C. Fletcher & W. L. Brown. (*Phys. Rev.*, 1st Nov. 1953, Vol. 92, No. 3, pp. 585–590.) A description is given of a three-stage process by which isolated pairs of interstitials and vacancies are thought to be removed. Approximate analytical expressions are derived for these stages. An outline is given of a more complete treatment with a quantitative

solution for one particular phase of the annealing in the diamond-type lattice.

537.312.5 : 546.482.21 **1478**

Influence of Temperature and Oxygen on the Build-Up and Decay of the Photoconductivity of CdS Single Crystals.—B. Seraphin. (*Ann. Phys., Lpz.*, 20th Oct. 1953, Vol. 13, Nos. 1/5, pp. 198–213.)

537.32 **1479**

Thermoelectric Power of Monovalent Metals at High Temperature.—D. K. C. MacDonald & S. K. Roy. (*Phil. Mag.*, Dec. 1953, Vol. 44, No. 359, pp. 1364–1370.) An analysis based on band theory.

537.323 : 669.7.018 **1480**

Thermoelectric Power of Alloys.—J. Friedel. (*J. Phys. Radium*, Nov. 1953, Vol. 14, No. 11, pp. 561–565.) Mott's calculation for the resistivity when polyvalent impurities (e.g. Zn, Ga, Ge) are substituted in monovalent metals such as Cu is extended to determine the thermoelectric power. The order of magnitude and the variation as a function of impurity concentration are in agreement with experimental results. For Al alloys, in order to obtain theoretical results in agreement with observations, it is necessary to assume two overlapping energy bands.

537.533.8 **1481**

Some Characteristics of Secondary Emission from BeCu.—F. J. F. Osborne. (*Canad. J. Phys.*, Nov. 1953, Vol. 31, No. 7, p. 1189.) An investigation was made of the energy distribution of secondary electrons emitted from BeCu and other metal surfaces bombarded by primary electrons; the target was placed at the centre of a sphere to which a variable positive or negative bias was applied. The results are plotted as percentage of total secondary current against sphere bias.

538.221 **1482**

Quantum Theory of a Newly Proposed Origin of Ferromagnetism.—G. Heber. (*Ann. Phys., Lpz.*, 20th Oct. 1953, Vol. 13, Nos. 1/5, pp. 44–72.) Zener's theory, that ferromagnetism originates from the interaction between the 3*d* and the 4*s* electrons of a crystal, is discussed in conjunction with Heisenberg's theory, based on interaction between the 3*d* electrons among themselves.

538.221 **1483**

Orientational Superstructures due to Mechanical Deformations.—L. Néel. (*C. R. Acad. Sci., Paris*, 18th Jan. 1954, Vol. 238, No. 3, pp. 305–308.) Development of work previously noted (1101 of April).

538.221 **1484**

Magnetic Moments and Crystal Structures of Ferromagnetic Metals and Alloys.—F. Gal'perin. (*C. R. Acad. Sci. U.R.S.S.*, 1st Feb. 1953, Vol. 88, No. 4, pp. 643–646. In Russian.) An expression for the magnetic moment is given by analogy with a previously published formula (2444 of 1951) in terms of lattice constants. These constants are given in Table I for some pure metals, pure ferrites and materials of ferroxdure type. The calculated magnetic moments, given in fractional numbers of magnetons, are in good agreement with experimental values given in the last column. The dependence of the molecular magnetic moments of mixed ferrites on the relative concentrations of the components is shown in Fig. 1, where the curves, calculated from the given expression, are compared with the results of measurements by Gorter (1931 of 1950) and by Guillaud.

538.221 : 539.382 : 546.74 **1485**

Investigation of the ΔE Effect and the Damping of Elastic Waves in Polycrystalline Nickel by an Acoustic Method.—V. P. Sizov. (*C. R. Acad. Sci. U.R.S.S.*, 21st March 1953, Vol. 89, No. 3, pp. 427–430. In Russian.) Young's modulus (E) of 99·5% pure Ni wire was determined by the method of longitudinal resonant oscillations at the fundamental frequency (about 12 kc/s). The effects of magnetic fields up to 1 215 oersted were measured. Graphs of E/H, of $(\Delta E/E)/(J/J_s)$, where J_s is the intensity of magnetization at saturation, and of the variation in the amplitude and the decrement with H are given for differently treated wires.

538.221 : 621.318.12/.13 **1486**

Investigation of the Frequency Dependence of the Material Constants of Mixed Ferromagnetic Bodies up to Very High Frequencies.—W. Heister. (*Arch. Elektrotech.*, 1953, Vol. 41, No. 3, pp. 142–160.) The dielectric and magnetic properties of Ni-Zn, Cu-Zn and Mn-Zn ferrites and of dust cores of various grades and grain sizes of carbonyl iron, carbonyl nickel, hametag iron and cobalt were investigated at frequencies between 50 c/s and 4 kMc/s. At high frequencies volume resonance effects, due to capacitive eddy currents, were observed; these are explained by using the results of the dielectric measurements. The frequency characteristics can be determined from the properties of the individual particles; a comparison with experimental results is made.

538.221 : 621.318.134 **1487**

Ferrites — Properties and Applications.—H. Lennartz. (*Funk u. Ton*, Dec. 1953, Vol. 7, No. 12, pp. 613–627.) A survey. A table is given of the magnetic characteristics of 29 commercial magnetically soft ferrites manufactured in Holland and Germany. 33 references.

538.221 : 621.318.134 : 538.662 **1488**

Temperature Dependence of Magnetization Curves of Nickel-Zinc Ferrites in Weak Fields.—A. P. Komar & N. M. Reinov. (*C. R. Acad. Sci. U.R.S.S.*, 1st Nov. 1953, Vol. 93, No. 1, pp. 19–20. In Russian.) I/H characteristics determined at room temperature and at the temperatures of liquid N, H and He are shown graphically.

538.221: 621.318.2 **1489**

Steels for Permanent Magnets.—J. C. Williamson. (*Elect. Rev., Lond.*, 13th Nov. 1953, Vol. 153, No. 20, pp. 1101–1105.) The main types are surveyed briefly; two categories are distinguished, namely, quench-hardened steels and precipitation-hardened alloys. Composition and properties are tabulated.

546.23 : 537.226.8 : 621.314.634 **1490**

The Dielectric Behaviour of Selenium Barrier-Layers under Temperature Loading in the Blocking Region.—H. H. Rust. (*Arch. elekt. Übertragung*, Nov. 1953, Vol. 7, No. 11, pp. 549–553.) The capacitance/temperature characteristic of Se barrier layers initially exhibits a hysteresis effect which vanishes in subsequent temperature cycles. The variations of capacitance with time, following exposure to an increased temperature, and following a change in the applied bias potential, are shown graphically. The results are discussed and similarities with the characteristics of ferroelectric materials are noted.

548.7 **1491**

Imperfections in Matter.—G. W. Rathenau. (*Philips tech. Rev.*, Oct. 1953, Vol. 15, No. 4, pp. 105–113.) A general survey of the effects of crystal lattice imperfections on the properties of solids.

621.3.042.017.3 **1492**

Combined Magnetization of Magnetic Materials.—

J. E. Parton & W. D. Sutherland. (*Engineering, Lond.*, 27th Nov. & 4th Dec. 1953, Vol. 176, Nos. 4583 & 4584, pp. 687–700 & 731–732.) A detailed examination is made of the conditions produced when a magnetic core is simultaneously subjected to two or more magnetizing forces of different frequencies; the resulting iron losses are investigated.

669.04 **1493**

Preparation and Casting of Metals and Alloys under High Vacuum.—J. D. Fast, A. I. Luteijn & E. Overbosch. (*Philips tech. Rev.*, Oct. 1953, Vol. 15, No. 4, pp. 114–121.) A method is described for producing materials having the high degree of purity and precise composition required for physical investigations.

669.24 : 548.5 **1494**

Production of Single Crystals of Nickel.—R. F. Pearson. (*Brit. J. appl. Phys.*, Nov. 1953, Vol. 4, No. 11, pp. 342–344.) The growth by cooling from the melt, and the preparation of faces parallel to given crystal planes are described.

MATHEMATICS

512.3 **1495**

The Location of the Roots of Polynomial Equations by the Repeated Evaluation of Linear Forms.—L. Tasny-Tschiassny. (*Quart. appl. Math.*, Oct. 1953, Vol. 11, No. 3, pp. 319–326.)

517.512.3 **1496**

Legendre Functions of Fractional Order.—M. C. Gray. (*Quart. appl. Math.*, Oct. 1953, Vol. 11, No. 3, pp. 311–318.) Formulae are presented which were developed in connection with Schelkunoff's theory of aerials but are of general interest; computed values of the functions are tabulated and shown in curves.

MEASUREMENTS AND TEST GEAR

621.317.3 : 538.632 **1497**

Measurement of the Hall Effect in Cylinders without an External Magnetic Field.—G. Busch & R. Jaggi. (*Z. angew. Math. Phys.*, 15th Nov. 1953, Vol. 4, No. 6, pp. 425–433.) A current flowing in a cylindrical conductor gives rise to a Hall effect due to its own magnetic field. A simple method of measuring the effect, using either d.c. or a.c., is described. Results of measurements on polycrystalline Bi at 77°K and 290°K are shown graphically for different values of primary current; they are in good agreement with other published results.

621.317.3 : 621.314.632 : 546.289 **1498**

Use of the Germanium Rectifier for the Measurement of Current, Voltage and Power at High Frequency: Part 1 — Measurement of Current and Voltage.—J. Schiele. (*Arch. tech. Messen*, Dec. 1953, No. 215, pp. 285–288.) A survey relating particularly to Siemens Ge rectifiers, in which the crystal and point contact are sealed into a ceramic tube with metal end caps.

621.317.3 : 621.372.2.029.64 **1499**

Determination of Equivalent Circuit Parameters for Dissipative Microwave Structures.—L. B. Felsen & A. A. Oliner. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, pp. 477–483.) Measurement procedures are proposed based on Weissfloch's method of separating the network into lossy and loss-free parts (403 of 1944) and applicable for investigations of structures such as junctions between surface-wave or microstrip lines and their feed lines. Sample calculations are presented.

621.317.3 : 621.372.8 **1500**

An Elliptically-Polarized-Vibration Analyser for a Circular Waveguide in the 3-cm Waveband.—G. Raoult & A. Marcon. (*C. R. Acad. Sci., Paris*, 11th Jan. 1954, Vol. 238, No. 2, pp. 218–220.) An arrangement analogous to that used for optical polarization experiments is described. Two small aerials associated with resonators and crystal detectors are used to pick up the two components of the elliptically polarized wave. The ellipticity is determined by making measurements with and without a quarter-wave phase shifter in position.

621.317.32 : 621.314.63 **1501**

The Application of Barrier-Layer Rectifiers to the Measurement of Very Small Alternating Voltages.—F. Moeller. (*Arch. tech. Messen*, Nov. 1953, No. 214, pp. 263–266.) A comparison of the characteristics of Cu_2O, Se and Si or Ge point-contact rectifiers from the point of view of measurement of voltages <10 mV.

621.317.331 : 546.289 **1502**

Resistivity Measurements on Germanium for Transistors.—L. B. Valdes. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, pp. 420–427.) A method using four aligned probes is described; current is passed through the outer pair and the floating potential across the inner pair is measured. Formulae and curves are given for computing the resistivity for some particular arrangements.

621.317.35 : 535.37 **1503**

A New Method to Determine Short Decay Times of Phosphors excited with Ultraviolet Light.—A. Bril, H. A. Klasens & P. Zalm. (*Philips Res. Rep.*, Oct. 1953, Vol. 8, No. 5, pp. 393–396.) A c.r. tube with an ultraviolet-transmitting filter is used to provide excitation. The decay time of Sb-activated halophosphates is $\sim 5 \times 10^{-6}$ sec.

621.317.373 : 535.37 **1504**

Measurement of Luminescence Decay Time by means of the Phase [-detector] Valve.—F. Rohde. (*Z. Naturf.*, Feb./March 1953, Vol. 8a, Nos. 2/3, pp. 156–161.) The screen is excited by an electron beam whose intensity is modulated at h.f., and the emitted light is picked up by a photomultiplier, producing a signal which is phase-shifted with respect to the modulating signal. The two signals are applied to a phase-detector valve, whose output gives an indication of the luminescence decay time. Measurements on various organic phosphors are reported

621.317.411.029.64 **1505**

The Determination of the Apparent Permeabilities of Ferromagnetic Metals at cm-Wavelengths.—E. Ledinegg & P. Urban. (*Arch. elekt. Übertragung*, Nov. 1953, Vol. 7, No. 11, pp. 523–530.) Methods based on cavity-resonator and Lecher-wire measurements are described, the permeabilities being calculated from the detuning effect and the damping produced by a probe formed of the material under test.

621.317.42 : 538.221 **1506**

Investigation of Self-Field Distortion in the Förster Probe in the presence of a Ferromagnetic Material.—F. Brandstaetter. (*Elektrotech. u. Maschinenb.*, 15th Oct. 1953, Vol. 70, No. 20, pp. 452–455.) The Förster probe consists basically of a twin-core transformer with the lines of force completed through air paths, the secondaries being wound so as to provide compensation in the absence of external magnetic fields. When used for testing ferromagnetic materials, the probe field gives rise to irreversible processes which are however reduced to a small residual value due to the movement of the probe along the test piece.

621.317.431/.44 **1507**

An Improved Form of Hysteresis-Loop Plotter for Magnetic Materials.—A. D. Booth. (*J. sci. Instrum.*, Oct. 1953, Vol. 30, No. 10, pp. 384–385.) The use of a feedback integrator in the conventional c.r.o. hysteresis-curve plotter circuit results in a decreased time constant for a given accuracy, increased stability and freedom from unwanted pick-up. Hysteresis curves of toroidal cores can be obtained by winding one or two turns only and using a 1:60 step-up transformer.

621.317.444 **1508**

A Recording Fluxmeter.—R. S. Tebble. (*J. sci. Instrum.*, Oct. 1953, Vol. 30, No. 10, pp. 369–371.) The deflection of the Grassot fluxmeter coil is recorded as a change in the voltage induced in a mutual inductor, the primary of which is fixed and the secondary attached to the fluxmeter coil. The apparatus is described and the elimination of various errors is discussed.

621.317.7 : 621.3.018.78 **1509**

Measurement of Harmonic Distortion.—T. D. Conway. (*Wireless World*, March 1954, Vol. 60, No. 3, pp. 110–112.) Description of a self-contained direct-reading instrument for works testing and servicing, particularly for magnetic-tape recorders.

621.317.7.029.63/.64 : 621.372.43 **1510**

A U.H.F. and Microwave Matching Termination.—R. C. Ellenwood & W. E. Ryan. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, pp. 476–477.) Discussion on 1073 of 1953.

621.317.71 **1511**

High-Sensitivity Monofilar Electrometer.—Ouang Te-Tchao, E. Montel & P. Pannetier. (*J. Phys. Radium*, Nov. 1953, Vol. 14, No. 11, pp. 627–629.) An instrument capable of detecting a charge of the order of 20 000 electrons is described.

621.317.72.027.2.083.5 **1512**

Moving-Coil Compensator for recording Small Direct Voltages.—E. Samal. (*Elektrotech. Z., Edn A*, 11th Oct. 1953, Vol. 74, No. 20, pp. 590–593.) The difference between the currents passed through a resistor from a variable source and due to application of the unknown e.m.f. is used to operate a variable mutual inductor which controls the current source.

621.317.725 **1513**

An Electrostatic Voltmeter with Linear Indication.—H. Greinacher. (*Bull. schweiz. elektrotech. Ver.*, 26th Dec. 1953, Vol. 44, No. 26, pp. 1081–1083.) The voltmeter described previously (947 of 1951) is modified to give a linear indication by using appropriately curved plates instead of plane ones.

621.317.729 **1514**

Low-Input-Capacity Probe.—G. L. Shultz. (*Rev. sci. Instrum.*, Nov. 1953, Vol. 24, No. 11, p. 1068.) Input capacitance is 4·5 pF measured at 1·5 Mc/s. Attenuation is linear for 10-μs pulses of amplitude between -6 V and $+11$ V.

621.317.734 : 621.314.7 **1515**

Transistorized Megohmmeter.—P. B. Helsdon. (*Wireless World*, March 1954, Vol. 60, No. 3, pp. 121–123.) Description of a compact two-range instrument with a transistor h.v. generator.

621.317.755 : [621.314.632 + 621.314.7 **1516**

A Double-Pulse Instrument for the Measurement of Time-Lag Phenomena in Crystal Diodes and Transistors.—T. Einsele. (*Funk u. Ton*, Nov. 1953, Vol. 7, No. 11, pp. 557–569.) The operation and parts of the circuit of the c.r.o. instrument are described. The duration of either pulse can be varied independently between 0·5 and 25 μs, the pulse separation can be varied between 0·5 and 50 μs and the pulse repetition frequency between 10 and 2 000/sec. The pulse amplitudes are equal, and variable between 1 and 200 V. Applications of the instrument include measurement of the variation with time of the barrier-layer resistance.

621.317.755 : 621.385.832 **1517**

A Sealed-Off Cathode-Ray Tube with a Very High Writing Speed.—Jackson, Hardy & Feinberg. (See 1619.)

621.317.755 : 621.385.832 **1518**

Multibeam Cathode-Ray Oscillograph.—Fert, Lagasse & Ollé. (See 1620.)

621.317.79 : 537.533 **1519**

High-Energy Bunched Beam Analyzer.—I. Kaufman. (*J. appl. Phys.*, Nov. 1953, Vol. 24, No. 11, p. 1413.) An arrangement for measuring the length of the bunches in an undulated high-energy electron beam, such as that described by Motz (2411 of 1951) for producing millimetre waves, includes a cavity resonator for converting the bunch length into an electron-energy range, followed by a magnetic field for separating the electrons according to their energies.

621.317.79 : 621.372.412 **1520**

A Review of Methods for Measuring the Constants of Piezoelectric Vibrators.—E. A. Gerber. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, p. 446.) Correction to paper abstracted in 3670 of 1953.

621.373 : 621.396.822 **1521**

Primary Standard Thermal Noise Generator.—G. Lynch. (*Radio & Telev. News, Radio-Electronic Engng Section*, Nov. 1953, Vol. 50, No. 5, pp. 10–12.) The noise generator described comprises a heated precision resistor matched to a coaxial line.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

539.32 : 534.321.9 **1522**

Determination of the Elastic Constants of Isotropic Solid Bodies, using Ultrasonic Waves.—E. Ledinegg & P. Urban. (*Acta phys. austriaca*, Oct. 1953, Vol. 8, No. 1, pp. 16–27.) Description of a resonance method using a cylindrical acoustic resonator into which rod or plate specimens are introduced. Formulae derived for thin specimens are in approximate agreement with corresponding formulae previously derived from perturbation theory (922 of April).

621.317.083.7 **1523**

Radio Telemetering.—E. D. Whitehead & J. Walsh. (*Proc. Instn elect. Engrs*, Part III, Jan. 1954, Vol. 101, No. 69, pp. 41–42.) Discussion on 1762 of 1953.

621.317.083.7 **1524**

A Transducer System for Remote Indication.—(*Engineer, Lond.*, 23rd Oct. 1953, Vol. 196, No. 5100, pp. 537–538.) The amount of unbalance introduced in a bridge-type circuit by a change of the e.m. coupling at the transducer is measured by a remote moving-coil meter. A 50-c/s mains supply is used.

621.317.083.7 : 621.396.934 **1525**

Telemetry for Guided Weapons.—(*Engineering, Lond.*, 23rd Oct. 1953, Vol. 176, No. 4578, pp. 518–519.) Air-

borne and ground-station equipment developed by the Ministry of Supply is described. For the transmission of information on control-surface positions, strains, pressures and torques a 23-channel low frequency time-sharing multiplex system is used, with an additional channel for synchronization. Information on waveforms occurring in the airborne electronic equipment is transmitted by 20 high-frequency channels, using p.p.m. and time-division systems.

621.318.5 : 551.571.3 **1526**

The Effect of Humidity Variation on the Operation of an Electronic Proximity Switch.—R. A. K. Long. (*J. sci. Instrum.*, Nov. 1953, Vol. 30, No. 11, pp. 422–424.) The change in electrode capacitance due to adsorption by the oxide layer and to permittivity and temperature variations can be eliminated by enclosing the electrode.

621.318.572 : 621.383 **1527**

A Bidirectional Electronic Counter for Use in Optical Interferometry.—F. H. Branin, Jr. (*J. opt. Soc. Amer.*, Oct. 1953, Vol. 43, No. 10, pp. 839–848.) An arrangement is described for counting interference fringes by deriving electrical sine waves from them by means of a stepped mirror and two photocells. Either a binary or a decimal system can be provided. Counting rates >150 000/sec have been achieved. Other applications of the counter are indicated, including use in analogue-to-digital converters.

621.384.611 **1528**

Favourable Operating Conditions for the Electron Cyclotron.—C. Schmelzer. (*Z. Naturf.*, Dec. 1952, Vol. 7a, No. 12, pp. 808–817.)

621.384.612 **1529**

Nonlinearities in the Strong-Focusing Accelerator.—E. R. Caianiello. (*Nuovo Cim.*, 1st May 1953, Vol. 10, No. 5, pp. 581–593. In English.) The effects of the nonlinearity of the magnetic field, due to the fact that it must satisfy the Maxwell equations, are shown to be negligible compared with other causes of error in the strong-focusing accelerator.

621.384.612 **1530**

Stability and Periodicity in the Strong-Focusing Accelerator.—E. R. Caianiello & A. Turrin. (*Nuovo Cim.*, 1st May 1953, Vol. 10, No. 5, pp. 594–603. In English.)

621.384.612 **1531**

Alignment Errors in the Strong-Focusing Synchrotron.—M. Sands & B. Touschek. (*Nuovo Cim.*, 1st May 1953, Vol. 10, No. 5, pp. 604–613. In English.) Distortion of orbits due to misalignment of the sectors is investigated.

621.384.612 **1532**

Orbital Instabilities due to Nonlinearities in the Cosmotron.—J. Seiden. (*C. R. Acad. Sci., Paris*, 11th Jan. 1954, Vol. 238, No. 2, pp. 230–232.)

621.384.622.2 **1533**

8-MeV Linear Accelerator for X-Ray Therapy.—(*Engineer, Lond.*, 30th Oct. 1953, Vol. 196, No. 5101, pp. 554–556.) Description of travelling-wave accelerator installed at Hammersmith Hospital, London.

621.385.832[.833] : 621.3.032.28 : 538.691 **1534**

Magnetic Electron Lens Aberrations due to Mechanical Defects.—G. D. Archard. (*J. sci. Instrum.*, Oct. 1953, Vol. 30, No. 10, pp. 352–358.) A modification of Sturrock's computational procedure (1074 of 1952) is used. The results are presented in the form of universal curves designed to facilitate the assignment of tolerances for lenses of any magnitude and any accelerating potential.

621.385.833 **1535**

Numerical Integrations of the Equation of Electron Trajectories.—M. Laudet. (*J. Phys. Radium*, Nov. 1953, Vol. 14, No. 11, pp. 604–610.)

621.385.833 **1536**

The Sensitivity of Simple Electron-Optical Schlieren Arrangements.—W. Rollwagen & C. Schwink. (*Optik, Stuttgart*, 1953, Vol. 10, No. 11, pp. 525–530.) Methods of the type described by Marton & Lachenbruch (1211 of 1950) for investigating electromagnetic fields are considered. A study is made of the different possible arrangements including an electron lens.

621.385.833 **1537**

Numerical Calculation of the Paths in Rotationally Symmetrical Electron-Optical Systems.—P. Gautier. (*J. Phys. Radium*, Oct. 1953, Vol. 14, No. 10, pp. 524–532.)

621.387.424 **1538**

The Mechanism of the Discharge in Argon-Filled Counters.—L. Colli & U. Facchini. (*Nuovo Cim.*, 1st Dec. 1952, Vol. 9, No. 12, pp. 1183–1217.)

621.387.424 **1539**

Investigation of the Discharge and of Post-Discharge Phenomena in G-M Counters, by means of X-Ray Pulses.—P. Müller. (*Ann. Phys., Lpz.*, 20th Oct. 1953, Vol. 13, Nos. 1/5, pp. 110–135.)

621.387.424 **1540**

Geiger-Müller Counters with Binary Mixtures of Rare Gas and Organic Vapour.—R. Meunier, M. Bonpas & J. P. Legrand. (*J. Phys. Radium*, Nov. 1953, Vol. 14, No. 11, pp. 630–634.)

621.397.3 **1541**

Processing of Two-Dimensional Patterns by Scanning Techniques.—L. S. G. Kovasznay & H. M. Joseph. (*Science*, 23rd Oct. 1953, Vol. 118, No. 3069, pp. 475–477.) A system comprising a flying-spot scanner and oscilloscope monitor is used to study processes involved in the recognition and recollection of patterns. Contour enhancement is achieved by combining the picture signal with its second derivative. The possibility of achieving various other unusual effects by circuit means is indicated.

535.37 : 621.387.464 **1542**

Luminescence and the Scintillation Counter. [Book Review]—S. C. Curran. Publishers: Butterworths Scientific Publications, London, 32s. 6d. (*Engineering, Lond.*, 20th Nov. 1953, Vol. 176, No. 4582, p. 644.) A compact and comprehensive guide to modern theory and practice.

PROPAGATION OF WAVES

538.566 **1543**

Note on W. H. Wise's Proof of the Nonexistence of the Zenneck Surface Wave in the Field of an Aerial.—H. Ott. (*Z. Naturf.*, Jan. 1953, Vol. 8a, No. 1, pp. 100–103.) It is shown that Wise's proof (1690 of 1937) does not exclude all possibility of the existence of a surface-wave component in the distant field of a dipole.

538.566 : 551.594.6 **1544**

Harmonic Fields in the Propagation of Long Electric Waves round the Earth, and Lightning Waveforms.—

W. O. Schumann. (*Naturwissenschaften*, Oct. 1953, Vol. 40, No. 19, pp. 504–505.) The work noted in 1772 and 3597 of 1953 is extended to include a study of the harmonic fields of a vertical and of a horizontal dipole. The analysis indicates that the harmonic fields of vertical lightning flashes vanish at large distances, owing to attenuation; for horizontal flashes the lowest possible propagation frequency is 3 330 c/s, and only the harmonics are propagated, the lowest being the least attenuated.

538.566 : 551.594.6 **1545**

The Propagation of Very Long Electric Waves round the Earth, and Atmospherics.—W. O. Schumann. (*Nuovo Cim.*, 1st Dec. 1952, Vol. 9, No. 12, pp. 1116–1138.) Using the method of singular eigenfunctions, a formula is found for the propagation of long waves, taking account of the influence of the ionosphere. Expressions for the propagation of atmospherics are hence found by Fourier integration, assuming various simple time functions for the lightning waveform.

621.396.11 **1546**

Theoretical Resonance Curves in the Gyro-interaction of Electromagnetic Waves in the Ionosphere.—F. H. Hibberd. (*Nuovo Cim.*, 1st April 1953, Vol. 10, No. 4, pp. 380–385. In English.) Motzo's results (2111 of 1953) are discussed and it is shown that for vertically incident waves either single or double maxima may occur, and that there is little difference in the general shape of the curves resulting from vertically incident and obliquely incident waves.

621.396.11 **1547**

The Application of High-Frequency Radio-Propagation Predictions in the New Zealand Area.—G. McK. Allcock. (*N.Z. J.Sci.Tech.B*, Sept. 1953, Vol. 35, No. 2, pp. 198–212.) The results of propagation measurements at 9·15 Mc/s over an 800-km path along a geomagnetic meridian indicate that the m.u.f.'s for 3000-km and 800-km paths are related by the equation (M800) = 0·38(M3000) + 0·37. The frequency separation between the m.u.f.'s for the ordinary and extraordinary waves is approximately one-half the gyro-frequency.

621.396.11 : 551.510.52 **1548**

The Troposphere as a Medium for the Propagation of Radio Waves: Part 1.—H. Bremmer. (*Philips tech. Rev.*, Nov. 1953, Vol. 15, No. 5, pp. 148–159.) A review paper.

621.396.11 : 551.510.535 **1549**

Double Refraction in the Ionosphere.—R. W. Larenz. (*Naturwissenschaften*, Oct. 1953, Vol. 40, No. 20, p. 527.) The variation of the real part of the refractive index with the plasma frequency is shown graphically for different values of the angle between the direction of wave propagation and the magnetic field. When the effect of electron pressure is taken into account triple refraction is found to be produced. Only two of the wave components have group velocities of the order of the velocity of light. The results are consistent with the triple refraction observed by Dieminger & Möller (2791 of 1949).

621.396.11 : 551.510.535 **1550**

Some Notes on the Absorption of Radio Waves Reflected from the Ionosphere at Oblique Incidence.—W. J. G. Beynon. (*Proc. Instn elect. Engrs*, Part III, Jan. 1954, Vol. 101, No. 69, pp. 15–20.) For conditions in which partial reflection or scattering at the E region is the dominant cause of attenuation of the first-order F-layer reflection, a new equivalence theorem in better agreement with observations on both long and short transmission paths is proposed to replace Martyn's relation (*Proc. phys. Soc.*, 1935, Vol. 47, pp. 323–339). In this new theorem, the apparent absorption at frequency f and angle of incidence i is equivalent to the apparent absorption at frequency $f \cos i$ and normal incidence. The influence of multiple echoes on received signal strength is also considered.

621.396.11.029.422 **1551**

An Experimental Investigation of Short-Distance Ionospheric Propagation at Low and Very Low Frequencies.—H. G. Hopkins & L. G. Reynolds. (*Proc. Instn elect. Engrs*, Part III, Jan. 1954, Vol. 101, No. 69, pp. 21–34.) Observations were made between 1948 and 1951 at distances between 60 and 210 km from commercial c.w. transmitters operating at four frequencies in the range 16–85 kc/s. The experimental method mainly used was similar to that described by Best et al. (*Proc. roy. Soc. A*, 1936, Vol. 156, p. 614). The equipment used is described and the results obtained are discussed critically in relation to similar work performed elsewhere. Pulse-sounding technique has advantages over the c.w. method for the frequency band considered.

621.396.11.029.64 : 551.510.52 **1552**

The Effect of the Oceanic Duct on Microwave Propagation.—L. J. Anderson & E. E. Gossard. (*Trans. Amer. geophys. Union*, Oct. 1953, Vol. 34, No. 5, pp. 695–700.) Radio and meteorological observations obtained over Cardigan Bay are analysed. For propagation at a wavelength of 3 cm, agreement between observation and theory improves as wind speed increases. At the lower wind speeds scatter is noted; possible explanations of this scatter are discussed. For propagation at a wavelength of 9 cm more scatter is observed and the transition to trapping conditions is less definite.

621.396.81 **1553**

Radio Survey Technique.—S. H. Wilkinson. (*A.T.E. J.*, Oct. 1953, Vol. 9, No. 4, pp. 216–228.) A description is given of the survey unit previously mentioned (234 of January). Experimental and theoretical methods of determining path attenuation are discussed. An account is given of typical surveys which have been made to obtain data on propagation and on equipment performance.

621.396.812.3.029.65 **1554**

Some Measurements of Fading at a Wavelength of 8 mm over a Very Short Sea Path.—D. G. Kiely. (*J. Brit. Instn Radio Engrs*, Feb. 1954, Vol. 14, No. 2, pp. 89–92.) Measurements were made, over a five-week period, of the fluctuations of signals transmitted over a 1-mile path, using a transmitter site about 15 ft and a receiver site about 100 ft above sea level. The results indicate very large atmospheric-refraction effects.

RECEPTION

621.396.621.029.64 + 621.372.2.029.64/.65 **1555**

Experimental Determination of the Properties of Microstrip Components.—Arditi. (See 1296.)

621.396.82 : 061.3 **1556**

Radio Interference Conference.—(*Elect. J.*, 13th Nov. 1953, Vol. 151, No. 20, p. 1594.) Brief report of the proceedings of an international conference held in London, October 1953.

621.396.82 : 621.3.066.6 **1557**

Sliding Contacts — a Review of the Literature.—F. Spayth & S. East. (*Elect. Engng, N.Y.*, Oct. 1953, Vol. 72, No. 10, pp. 912–917.) The review includes results of measurements of mechanical and electrical

phenomena at motor or generator brush contacts. Tables are given of the variation of electrical noise with brush and ring material and with brush pressure. The experimental results are summarized in sets of general rules for designers. 43 references.

621.396.828 + [621.397.828 : 535.623 **1558**

Color Television and the Amateur.—G. Grammer. (*QST*, Nov. 1953, Vol. 37, No. 11, pp. 31–34..124.) Interference between transmissions in the 80-m band and the 3·58-Mc/s colour subcarrier was investigated. Interference in both services could largely be suppressed by good design in the layout, the screening and the filters of the television receiver.

621.396.828 **1559**

The Most Suitable Interference-Suppressor Circuit.—G. Strobel & H. Scherenzel. (*Frequenz*, Sept. & Oct. 1953, Vol. 7, Nos. 9 & 10, pp. 269–275 & 295–298.) The choice of the best arrangement for suppressing interference at the source requires a knowledge of the source impedance, the magnitude of the interference, the permissible interference limits and the electrical safety regulations. These points are discussed in detail in relation to the West German regulations for the 0·1–20-Mc/s frequency range, and the methods of measurement and application of the results are described.

STATIONS AND COMMUNICATION SYSTEMS

621.376 : 621.396 **1560**

Comparison of Amplitude and Angle Modulation for Narrow-Band Communication of Binary-Coded Messages in Fluctuation Noise.—G. F. Montgomery. (*Proc. Inst. Radio Engrs*,. Feb. 1954, Vol. 42, No. 2, pp. 447–454.) Consideration is given to the problem of choosing the best modulation system for transmitting messages over a given radio channel with less than a specified error and at the lowest cost for terminal equipment. Frequency-shift, phase-shift and on-off systems are examined. Curves of fractional error as a function of average carrier/noise ratio are derived for fading and nonfading carriers.

621.376.2 : 621.395.44 **1561**

Properties of a Sine Wave with Double Amplitude Modulation.—L. Le Blan. (*C. R. Acad. Sci., Paris*, 11th Jan. 1954, Vol. 238, No. 2, pp. 220–222.) Analysis indicates that crosstalk is present to a greater degree in a two-channel system with separate modulation of the positive and negative portions of the carrier than in the system using alternate positive and negative pulses (1176 of April).

621.376.3/.4 : 621.396.8 **1562**

Comparison between Frequency and Phase Modulation for transmitting Speech.—G. Fontanellaz. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st Dec. 1953, Vol. 31, No. 12, pp. 371–374. In German.) Calculation indicates that for the frequency range 300–3 400 c/s, ph.m. gives a receiver-output signal/noise ratio 8·2 db better than f.m., for the same h.f. signal/noise ratio and the same mean frequency deviation. The relations between intelligibility and signal/noise ratio for the two systems are also compared.

621.376.3.001.11 : 621.316.729 **1563**

Communications Synchronizing Systems.—F. T. Turner. (*Elect. Engng, N.Y.*, Oct. 1953, Vol. 72, No. 10, pp. 874–876.) The application of f.m. theory to conventional synchronizing systems leads to a simple evaluation of the minimum signal/noise ratio permissible in facsimile transmission. Expressions are also derived for the servo-mechanism loop function and for the requirements for establishing synchronism on the initial application of the synchronizing signal.

621.376.5.001.2 **1564**

Quantizing Noise of a Single-Integration Delta-Modulation System with an *N*-Digit Code.—H. van de Weg. (*Philips Res. Rep.*, Oct. 1953, Vol. 8, No. 5, pp. 367–385.) The signal/noise ratio of Δ-modulation is evaluated, for different numbers of coding digits, as a function of the ratio between sampling frequency and maximum signal frequency, and compared with Bennett's results (895 of 1949) for p.c.m. By applying the results to the case of speech transmission, Δ-modulation is shown to be superior to p.c.m. for any given sampling frequency and number of digits.

621.39 **1565**

[British] **Commonwealth Telecommunications.**—J. A. Smale. (*Proc. Instn elect. Engrs*, Part III, Jan. 1954, Vol. 101, No. 69, pp. 1–4.) Chairman's address, Radio Section, I.E.E. A survey of developments in the complementary use of cable and wireless routes.

621.39.001.11 : 016 **1566**

A Bibliography of Information Theory (Communication Theory—Cybernetics).—F. L. Stumpers. (*Trans. Inst. Radio Engrs*, Nov. 1953, No. PGIT-2, pp. 1–60.) A comprehensive bibliography, including books and papers, arranged under the following headings:—(*a*) general theory; (*b*) bandwidth and transmission capacity, time-frequency uncertainty; signal/noise ratios, comparison of systems; instantaneous frequency; analytical signals; (*c*) definition, relation to statistical mechanics, philosophy; (*d*) correlation, prediction, filtering, storage; (*e*) radar; radio navigation; (*f*) speech; hearing; vision; linguistics; semantics; (*g*) other biophysical applications; human engineering; group communication; (*h*) television; (*i*) miscellaneous applications; optics; games; servo-mechanisms; (*j*) mathematics; statistics; games; relay algebra; noise analysis; (*k*) pulse modulation; multiplex coding.

621.39.001.11 : 519.2 **1567**

Fundamentals of Information Theory.—C. Lafleur. (*HF, Brussels*, 1953, Vol. 2, No. 8, pp. 219–228.) The two axioms stated by Woodward & Davies (1724 of 1952) based on *a priori* and *a posteriori* probabilities are applied to derive Wiener's criterion for optimum filtering and Shannon's formulae regarding entropy and equivocation.

621.391 : 621.376.5 **1568**

A Recent Development in Communication Technique.—C. W. Earp. (*Proc. Instn elect. Engrs*, Part III, Jan. 1954, Vol. 101, No. 69, p. 20.) Discussion on 2889 of 1952.

621.395.44 : 621.315.052.63 **1569**

Transmission Power and Range of Carrier-Frequency Communication Equipment for High-Voltage Lines.—H. K. Podszeck & A. Schmid. (*Elektrotech. Z., Edn A*, 11th Oct. 1953, Vol. 74, No. 20, pp. 586–589.) Multichannel single- and double-sideband transmissions using carrier frequencies in the range 30–450 kc/s are considered from the power efficiency point of view. Formulae and graphs are given for the effects due to the depth of modulation, the number of channels and sidebands, and the type of application, e.g., telephony, remote control and measurement.

621.395.44 : 621.315.052.63 **1570**

New Line of Power-Line Carrier Equipment.—F. B. Gunter. (*Elect. Engng, N.Y.*, Nov. 1953, Vol. 72, No. 11,

p. 965.) Digest of paper to be published in *Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72. Performance characteristics of multi-purpose equipment are outlined.

621.395.44 : 621.315.212 **1571**

Potentialities and Limitations of a Coaxial-Cable Multichannel System.—F. Locher. (*Bull. schweiz. elektrotech. Ver.*, 3rd Oct. 1953, Vol. 44, No. 20, pp. 861–875.) A review of development and present-day coaxial-cable technique in Europe and the U.S.A.

621.395.44 : 621.375.2 **1572**

The Coaxial-Line Amplifier.—J. Bauer. (*Bull. schweiz. elektrotech. Ver.*, 3rd Oct. 1953, Vol. 44, No. 20, pp. 881–884; *Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st Jan. 1954, Vol. 32, No. 1, pp. 31–35.) Description of the amplifier designed for the Bern-Morteau line, and comprising two units in tandem, with associated equalizer, temperature compensator and separating network equipment.

621.396 + 621.397] : 061.3 **1573**

The New C.C.I.R. Resolutions.—Fetzer. (See 1587.)

621.396.4 : 621.396.65 **1574**

Experimental Radio Bearer Equipment for Carrier Telephone Systems.—W. S. McGuire & A. G. Bird. (*A.W.A. tech. Rev.*, Oct. 1953, Vol. 9, No. 4, pp. 227–254.) Reprint. See 3412 of 1953.

621.396.41.029.62 **1575**

Some Factors in the Engineering Design of V.H.F. Multichannel Telephone Equipment.—W. T. Brown. (*J. Brit. Instn Radio Engrs*, Feb. 1954, Vol. 14, No. 2, pp. 51–74. Discussion, pp. 75–77.) The principal clauses of a specification for a v.h.f. multichannel radiotelephone installation are discussed generally. Particular attention is given to ancillary equipment for automatic changeover, remote control and fault warning. The layout and aerial arrangements are described.

621.396.65 : 621.396.41.029.64 **1576**

A Multichannel Microwave Relay System.—R. D. Boadle. (*A.W.A. tech. Rev.*, Oct. 1953, Vol. 9, No. 4, pp. 209–226.) Reprint. See 3110 of 1953.

621.396.65.029.6.001.4(44 + 494) **1577**

Testing Radio-Link Transmission over a Long Line-of-Sight Path between France and Switzerland.—W. Klein & L. J. Libois. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.* 1st Nov. 1953, Vol. 31, No. 11, pp. 305–317. In French.) A report of measurements made, during the period 1950–1952, of test transmissions on 300 and 3 000 Mc/s over a 160-km path between Chasseral and Mont-Afrique. Results show that multichannel or television transmission satisfying C.C.I.F. specifications is quite practicable. Path attenuation during the period was less variable than for other paths only half as long; this is attributed to the presence of obstacles along the path which scarcely affect the direct wave, but cause considerable attenuation of indirect waves by diffraction. The correlation of reception conditions with meteorological data is discussed, in particular the coincidence of severe fades at 300 Mc/s with the presence of zones of superrefraction. See also *Onde élect.*, Dec. 1953, Vol. 33, No. 321, pp. 665–677.

621.396.664 : 621.396.712 **1578**

Random Sequence Switching.—A. B. Ettlinger. (*Electronics*, Feb. 1954, Vol. 27, No. 2, pp. 165–167.) In a system for automatic control of a group of broadcasting stations for civil-defence purposes, the programme is continuously fed to all the transmitters in the group and each transmitter is equipped with a tone-operated relay so that power is applied only when a 7-kc/s tone is superimposed on the line; this tone is switched in a random manner by means of a thermal delay device.

621.396.712.2 : 534.76 **1579**

Audio Equipment for Binaural Broadcasts.—L. J. Kleinklaus. (*Electronics*, Feb. 1954, Vol. 27, No. 2, pp. 134–135.) Description of two portable units, namely a two-channel preamplifier-mixer and a monitor amplifier, used at the WQXR station, which broadcasts simultaneously in an a.m. and a f.m. channel.

621.396.932 **1580**

Re-equipping Coast Radio Stations.—(*Elect. J.*, 6th Nov. 1953, Vol. 151, No. 19, pp. 1475–1476.) Brief details are given of equipment installed by the British Post Office to meet developments in ship-to-shore communications and related techniques.

621.396.933 : 621.396.3 **1581**

Notes on the Radiotelegraphic Connection between the K.L.M. Liftmaster 'Dr. Ir. M. H. Damme' and the Schiphol Air Traffic Control Station PKH during the Christchurch Flight on 8th, 9th and 10th Oct. 1953.—(*Tijdschr. ned. Radiogenoot.*, Nov. 1953, Vol. 18, Nos. 5/6, pp. 313–315.) A log is given of the times during which contact was made. The Karachi, Biak and Djakarta stations co-operated in the check.

SUBSIDIARY APPARATUS

621-526 **1582**

The Application of Statistical Methods to Servomechanisms.—R. E. Vowels. (*Aust. J. appl. Sci.*, Dec. 1953, Vol. 4, No. 4, pp. 469–488.) "The optimum transfer function for the desired response to a stationary random input signal containing noise may be determined by the Wiener-Lee method. In general, when applied to servomechanisms design, the output will not necessarily have zero steady-state error. In order to overcome this disadvantage, constraints may be applied in the Wiener-Hopf equation such that any of the error coefficients of the servomechanism are zero, and at the same time the output is optimized. It is also possible to include prediction, differentiation, or integration of the input function as desirable outputs."

621.316.721/.722 **1583**

Series Operation of a Glow-Discharge Tube and a Barretter.—F. A. Benson. (*Elect. J.*, 23rd Oct. 1953, Vol. 151, No. 17, pp. 1291–1293.) The replacement of the series resistor by a barretter results in improved stabilization. The operation of the Type-CV1199 glow-discharge tube (180 mA max.) with Type-161 barretter (160 mA) was investigated and the batch variations of the Type-161 barretter characteristics were examined.

621.316.722.1 **1584**

Stabilizer for Alternating Voltages.—A. Riedel. (*Nachr-Tech.*, Oct. 1953, Vol. 3, No. 10, pp. 460–464.) The design of a biased-reactor arrangement having good frequency independence and satisfactory speed of operation is discussed.

621.316.722.1.076.7 **1585**

A Stable Source of High Voltage.—L. U. Hibbard & D. E. Caro. (*J. sci. Instrum.*, Oct. 1953, Vol. 30, No. 10, pp. 378–380.) A voltage regulator suitable as a voltage reference at about 1 000 V with current up to several milliamperes is described. With the temperature controlled to within $\pm$ 1°C, the output is stable to within $\pm$ 1 part in 10^4 over 8 hours. Effects of varying magnetic fields $<$ 15 gauss are negligible.

621.316.93 : 621.396.933 **1586**

Aircraft Protection from Thunderstorm Discharges to Antennas.—J. M. Bryant, M. M. Newman & J. D. Robb. (*Elect. Engng, N.Y.*, Oct. 1953, Vol. 72, No. 10, pp. 880–884.) The protection unit described consists of a 10^{-3}F 10-kV capacitor in the aerial feeder lead together with a spark gap in parallel with a resistor, connected between the aerial side of the capacitor and the fuselage. A peak-current recorder, in the form of a steel strip magnetized by the current flow, is included. Units of this type have been tested for over two years in commercial airliners.

TELEVISION AND PHOTOTELEGRAPHY

621.397 + 621.396] : 061.3 **1587**

The New C.C.I.R. Resolutions.—V. Fetzer. (*Funk u. Ton*, Nov. & Dec. 1952, Vol. 6, Nos. 11 & 12, pp. 591–596, 642–648 and Jan.–Nov. 1953, Vol. 7, Nos. 1–11, pp. 34–43, 84–89, 145–156, 205–208, 250–256, 315–318, 369–377, 414–419, 472–476, 535–544 & 590–593.) Detailed report of recommendations, numbered from 36 to 85, made by 13 study groups at the 6th Plenary Assembly, Geneva, 1951.

621.397.335 : 535.623 **1588**

Color Synchronization in the N.T.S.C. Color Receiver.—W. E. Good. (*Trans. Inst. Radio Engrs*, Oct. 1953, No. PGBTR-4, pp. 23–29.) The necessary phase accuracy is discussed, and the design and performance of several synchronizing circuits are compared. See also 1749 of 1952 (Dome).

621.397.5 : 535.623 **1589**

Color Television—a Primer on the N.T.S.C. System.—W. Feingold. (*Trans. Inst. Radio Engrs*, Oct. 1953, No. PGBTR-4, pp. 30–37.) An elementary treatment intended as an introduction to the subject.

621.397.5 : 535.623 **1590**

The Application of Colour to Television Broadcasting.—F. C. McLean. (*Engineering, Lond.*, 2nd Oct. 1953, Vol. 176, No. 4575, pp. 441–444.) Possible colour-television systems for use in Britain are discussed in relation to experience already gained with the N.T.S.C. system in the U.S.A. It is not yet certain that all the colour information can be transmitted within the 5-Mc/s channel. Separation of a colour subcarrier as used in the N.T.S.C. system would be more difficult with the British system because the sound channel is amplitude modulated. Receiver requirements are also discussed. For a summarized version, with comments, see *Wireless World*, Nov. 1953, Vol. 59, No. 11, p. 523.

621.397.5 : 621.395.625.3 **1591**

The Status of Magnetic Recording.—Zenner. (See 1291.)

621.397.62 **1592**

Design Techniques for Color Television Receivers.—M. H. Kronenberg & E. S. White. (*Electronics*, Feb. 1954, Vol. 27, No. 2, pp. 136–143.) Circuits for receiving the N.T.S.C. signals are discussed; details are given of particular designs, (*a*) for a receiver using the full potentialities of the system, and (*b*) for a simplified circuit with a colour bandwidth of 0·5 Mc/s.

621.397.62 : 535.623 **1593**

Color-Television-Signal Receiver Demodulators.—D. H. Pritchard & R. N. Rhodes. (*Trans. Inst. Radio Engrs*, Oct. 1953, No. PGBTR-4, pp. 1–22.) Reprint. See 3436 of 1953.

621.397.62 : 535.88 **1594**

An Apparatus for Aperture-Response Testing of Large Schmidt-Type Projection Optical Systems.—D. J. Parker, S. W. Johnson & L. T. Sachtleben. (*J. Soc. Mot. Pict. Telev. Engrs*, Dec. 1953, Vol. 61, No. 6, pp. 721–730.)

621.397.62 : 621.385.3 **1595**

The PCC 84 Double Triode.—(*Electronic Applic. Bull.*, Aug./Sept. 1953, Vol. 14, Nos. 8/9, pp. 113–120.) Valve data are given and the use of the valve as a cascode amplifier for the h.f. stage of a television receiver is described.

621.397.828 : 535.623] + 621.396.828 **1596**

Color Television and the Amateur.—Grammer. (See 1558.)

TRANSMISSION

621.396.61 **1597**

Some Aspects of the Design of Master-Oscillator Power-Amplifier Type Transmitters.—P. Howell. (*Radio & Electronics, Wellington, N.Z.*, 1st Dec. 1953, Vol. 8, No. 10, pp. 13–15, 31.) Various known circuits are discussed, and precautions necessary to prevent self-oscillation of the amplifier are indicated.

621.396.61.029.53/.55 **1598**

Automatic-Tuning Communication Transmitter.—M. C. Dettman. (*Elect. Commun.*, Dec. 1953, Vol. 30, No. 4, pp. 271–278.) Slightly modified version of paper in *Convention Record Inst. Radio Engrs*, 1953, Part 2, pp. 137–144. The transmitter is designed to meet service conditions, and has a frequency range 300 kc/s–26 Mc/s. There are ten preset channels and manual tuning facilities. Automatic-tuning time is about 30 sec for most frequencies. Nominal power output is 100 W over the range 300 kc/s–2 Mc/s and 100 W or 500 W over the range 2–26 Mc/s.

621.396.61.029.62 : 621.376.3 : 621.314.7 **1599**

Single-Transistor F.M. Transmitter.—D. E. Thomas. (*Electronics*, Feb. 1954, Vol. 27, No. 2, pp. 130–133.) Frequency modulation is achieved, in an experimental transmitter with a range of a few hundred feet, by shifting the alpha-cut-off frequency (about 40 Mc/s) of a point-contact transistor, the transmitter oscillator operating at about 105 Mc/s.

621.396.662 : 621.316.7 **1600**

Automatic Control System with Provision for Scanning and Memory.—N. H. Young. (*Elect. Commun.*, Dec. 1953, Vol. 30, No. 4, pp. 279–282; *Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, pp. 392–395.) See 884 of March.

VALVES AND THERMIONICS

537.533.8 : 621.373.4.029.63 **1601**

On the Time Delay of Secondary Emission.—G. Diemer & J. L. H. Jonker. (*Philips Res. Rep.*, Oct. 1953, Vol. 8, No. 5, p. 397.) Correction and addendum to paper noted in 1014 of 1951.

621.314.632 : 546.289 : 621.396.822.029.422/.5 **1602**

Measurements of Noise Spectra of a Point Contact Germanium Rectifier.—F. J. Hyde. (*Proc. phys. Soc.*, 1st Dec. 1953, Vol. 66, No. 408B, pp. 1017–1024.) The excess noise due to the passage of d.c. was measured at 29·5°C over the frequency range 0·117 c/s–14 Mc/s, with the reverse current I as parameter. The noise spectrum consists of three types of component, namely (*a*) a basic

component $\propto f^{-1}$, detectable over a frequency range of seven decades, (*b*) two components $\propto [1 + (2\pi f\tau)^2]^{-1}$ associated with relaxation times τ_1 and τ_2 and (*c*) a uniform component detectable at high frequencies and equal to the shot noise for small currents. The relaxation times are dependent on I.

621.314.632 : 546.289 : 621.396.822.029.426 **1603**

The Reduction of Rectifier Noise by Illumination.—J. W. Granville and A. F. Gibson. (*Proc. phys. Soc.*, 1st Dec. 1953, Vol. 66, No. 408B, pp. 1118–1119.) Noise in a Ge point-contact diode was measured at room temperature using an amplifier with a bandwidth of 1·4 c/s tuned to 16·5 c/s. The nonlinear variation of noise power per unit dynamic resistance with variation of the reverse current is shown graphically for several values of the distance between the light source and the rectifier.

621.314.7 **1604**

Transistor Reliability Studies.—R. M. Ryder & W. R. Sittner. (*Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, pp. 414–419.) The useful life of transistors may be shortened by conditions of high humidity or high temperature; the characteristics may also change due to surface contamination, mechanical disturbance or electrical or chemical effects. The mechanisms involved are described. A good measure of protection is obtained by sealing the transistor with a plastic.

621.314.7 **1605**

The Drift Transistor.—H. Krömer. (*Naturwissenschaften*, Nov. 1953, Vol. 40, No. 22, pp. 578–579.) The name 'drift transistor' is given to a junction transistor in which the concentration of impurity centres in the base falls exponentially between emitter and collector. An expression is derived for the rise of the upper frequency limit as compared with that for the ordinary junction transistor with uniform distribution of impurity centres in the base.

621.314.7 **1606**

German Transistors.—C. Möller. (*Funk-Technik, Berlin*, Nov. 1953, Vol. 8, No. 21, pp. 668–669.) Characteristics and operating data are given for several types of German-produced transistors. Applications are indicated.

621.314.7 : 546.28 **1607**

Enhanced Alpha in Formed Silicon Point-Contact Transistors.—H. Jacobs, W. Matthei & F. A. Brand. (*J. appl. Phys.*, Nov. 1953, Vol. 24, No. 11, pp. 1410–1411.) Point-contact transistors have been prepared by causing an impurity such as Sb to be diffused into a small region at or near the surface of *p*-type Si, using an arcing technique. High values of α (up to 10 or even more) are obtained. The transistor action is further enhanced by passing large currents in the reverse direction through the emitter. The properties of such Si transistors are compared with those of Ge types.

621.383.2 **1608**

Alkali Photocells: Part 1.—M. Ploke. (*Arch. tech. Messen*, Nov. 1953, No. 214, pp. 259–262.) A review of the theory and a survey of the principal types. Comparative data are given.

621.383.2 : 537.531 **1609**

Effect of X Rays on Photocells.—G. Blet. (*C. R. Acad. Sci., Paris*, 4th Jan. 1954, Vol. 238, No. 1, pp. 72–73.) The current output of an Se cell was measured for various values of incident X-ray energy. Taking account of the variation of absorption with wavelength, the results indicate that the current output per watt absorbed is constant. Estimates are made of the number of electrons emitted per photon absorbed.

621.383.27 **1610**

Recent Developments in Photocells with Secondary-Electron Multipliers.—N. Schaetti. (*Bull. schweiz. elektrotech. Ver.*, 14th Nov. 1953, Vol. 44, No. 23, pp. 989–995.) An account of work done at the Institut für technische Physik, Zürich. The photocathodes and multiplier arrangements are described, and some applications of photomultipliers are indicated.

621.383.27 : 546.36.86 **1611**

Control of the Characteristic of a Cs-Sb Photocathode by addition of Other Elements.—N. Schaetti. (*Z. angew. Math. Phys.*, 15th Nov. 1953, Vol. 4, No. 6, pp. 450–459.) Measurements on photomultipliers are reported. The dark current and the delayed emission following a period of illumination can be reduced by addition of various elements to the cathode material. The results for 14 different elements are tabulated.

621.383.4 **1612**

A Method of Describing the Detectivity of Photoconductive Cells.—R. C. Jones. (*Rev. sci. Instrum.*, Nov. 1953, Vol. 24, No. 11, pp. 1035–1040.) Detectivity in the reference condition C is given by an expression involving sensitive area and noise equivalent power of the cell, noise equivalent bandwidth of the amplifier used, and chopping frequency. Conditions of validity of the expression are stated and certain conventions relating to the measurement of the various quantities explained. The detectivity figure enables direct comparison to be made between two cells.

621.383.5: 546.561-31 **1613**

The Infrared Sensitivity of Cuprous-Oxide Photocells prepared at Reduced Pressure in a High-Frequency Field.—A. I. Andrievski & A. L. Rvachev. (*C. R. Acad. Sci. U.R.S.S.*, 11th March 1953, Vol. 89, No. 2, pp. 245–247. In Russian.) Two methods of manufacture using h.f. heating (~ 3 Mc/s) are described. Diverse spectral-sensitivity characteristics, shown graphically, were obtained by varying the pressure, the temperature and the time of oxidation and reduction. A cell with a maximum front-wall sensitivity in the green region and a maximum back-wall sensitivity in the red-to-infrared region, and a cell with maximum front-wall sensitivities in the green, red and infrared regions have been produced.

621.385.029.6 : 538.69 **1614**

Magnetrons.—P. H. J. A. Kleijnen. (*Tijdschr. ned. Radiogenoot.*, Nov. 1953, Vol. 18, Nos. 5/6, pp. 287–299.) Theory of the interaction between the electrons and the field is presented, with special reference to the mode spectrum of a rising-sun system.

621.385.029.63/.64 **1615**

The Effect of Line Attenuation on the Power Gain of a Travelling-Wave Valve.—W. Kleen & K. Föschl. (*Fernmeldetech. Z.*, Nov. 1953, Vol. 6, No. 11, pp. 509–516.) Theoretical treatment of the travelling-wave valve with (*a*) distributed and (*b*) localized attenuation introduced into the delay line to suppress unwanted feedback effects. Results are presented graphically for various values of space-charge and loss parameters. Distributed attenuation has an adverse effect on the attenuation constant for the amplified wave and on the partition of input power between the three waves excited. Localized attenuation causes a gain reduction dependent on the length of the attenuating element and on the plasma frequency.

621.385.029.63/.64 **1616**

Coaxial-to-Helix Transducers for Traveling-Wave Tubes.—R. E. White. (*Elect. Commun.*, Dec. 1953, Vol.

30, No. 4, pp. 300–304; *Convention Record Inst. Radio Engrs*, 1953, Part 10, pp. 42–45.) Design data are given for matching sections of ferrule type, with a tuning range up to 2 : 1, for small-diameter helices, and of tapered type, with a tuning range up to 4 : 1, for large-diameter helices.

621.385.029.63/.64 : 621.372.2 **1617**

Wave Propagation along a Helix with a Cylindrical Outer Conductor.—K. Pöschl. (*Arch. elekt. Übertragung*, Nov. 1953, Vol. 7, No. 11, pp. 518–522.) Formulae and curves are derived for the phase velocity, the characteristic impedance and the transfer impedance. These are valid over a wide range of wavelength and linear dimensions of the helix and cylinder, and reduce to a simple form when the phase velocity is small compared with the velocity of light.

621.385.029.63/.64 : 621.396.822 **1618**

Microwave Shot Noise in Electron Beams and the Minimum Noise Factor of Travelling Wave Tubes and Klystrons.—F. N. H. Robinson. (*J. Brit. Instn Radio Engrs*, Feb. 1954, Vol. 14, No. 2, pp. 79–86.) "A theorem recently proposed by J. R. Pierce concerning the intrinsic noise of electron streams is verified for electron beams originating in thermionic diodes under arbitrary conditions. The theorem is applied to the calculation of the minimum noise factor of klystrons and travelling wave tubes which is found to be 6 db. The treatment of partition noise is made possible by a generalization of the theorem."

621.385.032.21 : 546.841-31 **1619**

Thermionic Emission from Thin Layers of Thoria and Thorium on Molybdenum.—A. R. Shul'man & A. P. Rumyantsev. (*C. R. Acad. Sci. U.R.S.S.*, 21st Nov. 1953, Vol. 93, No. 3, pp. 455–458. In Russian.) Emission depends on several factors, in particular on (*a*) the penetration of the electric field inside the semiconducting surface layer, and (*b*) chemical or catalytic processes due to the base metal. Emission characteristics of variously treated cathodes were determined and the variation of work function and emissivity with thickness θ of the surface layer are shown graphically. θ is expressed as a number of monolayers; its value was determined from the α-particle emission.

621.385.032.216 **1620**

Cathode Parasitic Impedance.—M. Berthaud. (*Bull. Soc. franç. Élect.*, Nov. 1953, Vol. 3, No. 35, pp. 673–675.) The internal impedance developing in aged cathodes and generally ascribed to the formation of an interface layer has been measured by three methods which are outlined. Results are at variance with those of Eisenstein and others (2052 of 1951, 1812 of 1950 and back references), particularly as regards the dependence of this impedance on cathode temperature and valve current; it is inferred that the impedance is due to phenomena occurring not necessarily at the interface.

621.385.3 : 621.397.62 **1621**

The PCC 84 Double Triode.—(*Electronic Applic. Bull.*, Aug./Sept. 1953, Vol. 14, Nos. 8/9, pp. 113–120.) Valve data are given and the use of the valve as a cascode amplifier for the h.f. stage of a television receiver is described.

621.385.4.002.2 : [621.395.64 + 621.396.65 **1622**

The Telephone-Repeater Valve.—P. Meunier. (*Bull. Soc. franç. Élect.*, Nov. 1953, Vol. 3, No. 35, pp. 676–685.) Requirements in the design and manufacture of long-life valves of conventional type are discussed, in particular the steps taken to minimize cathode deterioration and its effects. Details are given of two tetrodes recently developed: (*a*) Type-PTT301 for submarine use, with a guaranteed life of 80 000 hours; (*b*) Type-PTT 243P, with a gain-bandwidth product of 200 Mc/s. The control-grid/cathode spacing of the latter is 0·0625 mm.

621.385.832 : 621.317.755 **1623**

A Sealed-Off Cathode-Ray Tube with a Very High Writing Speed.—B. Jackson, D. R. Hardy & R. Feinberg. (*Nature, Lond.*, 5th Dec. 1953, Vol. 172, No. 4388, pp. 1056–1057.) In an e.s.-deflection tube for direct observation and photographic recording of nonrecurrent high-voltage signals, the vertical deflection system comprises a straight twin-wire transmission line arranged perpendicular to the tube axis. The low-frequency deflection sensitivity is 0·006 mm/V at a beam-accelerating voltage of 25 kV. Writing speeds as high as $6{\cdot}6 \times 10^{10}$ cm/s have been attained.

621.385.832 : 621.317.755 **1624**

Multibeam Cathode-Ray Oscillograph.—C. Fert, J. Lagasse & J. Ollé. (*C. R. Acad. Sci., Paris*, 4th Jan. 1954, Vol. 238, No. 1, pp. 59–61.) A tube is described in which all the beams when undeflected strike the screen at the same spot. The single gun produces a beam which diverges from a narrow crossover and passes through apertures arranged in a coaxial ring in a diaphragm; a magnetic lens is used to bring the beams together again on the screen. Common magnetic horizontal-deflection and individual e.s. vertical-deflection systems are used. An illustration is shown of a four-trace recording obtained.

621.385.832 + 621.387] : 621.318.572 **1625**

Decimal Counting Tubes.—K. Kandiah. (*Electronic Engng*, Feb. 1954, Vol. 26, No. 312, pp. 56–63.) A survey of available types, classed as gas-filled, c.r.-tube and trochotron. Resolving times of circuits using these tubes, and tolerances on components and supply voltages are discussed.

621.385.832 : 621.395.625.3 **1626**

Visual Monitor for Magnetic Tape.—Miller. (See 1290.)

621.387 : 621.373.432 **1627**

Control of Glow-Discharge Triodes by means of Very Small Currents.—Meili. (See 1351.)

621.387 : 621.395 **1628**

New Thyratrons for Telephone-Circuit Engineering: Part 2 — Coincidence Thyratrons with Screen Grids and their Static Ignition Characteristics. Dynamic Ignition Characteristics.—K. L. Rau. (*Frequenz*, Sept. 1953, Vol. 7, No. 9, pp. 249–255.) The effect of various constructions of the screen grid on the valve characteristics is discussed. Part 1: 3156 of 1953.

MISCELLANEOUS

061.6 : 538.56.029.6 **1629**

Centre for the Study of Microwave Physics [at Florence]. —N. Carrara. (*Ricerca sci.*, Jan. 1954, Vol. 24, No. 1, pp. 31–34.) Report of activities during the year 1952; the construction of new instruments for wavelength measurements and devices for investigating microwave optics is mentioned.

061.6 : 621.3 **1630**

The Galileo Ferraris National Electrotechnical Institute. —P. Lombardi. (*Ricerca sci.*, Dec. 1953, Vol. 23, No. 12, pp. 2161–2231.) A report is given of the activities of the institute during the period 1949–1951, and the organizational structure is described. The subjects investigated include magnetic and dielectric materials, electroacoustics, electron tubes and radio engineering.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.121.1 **1631**

Concerning Combined and Degenerate Vibrations of Plates.—M. D. Waller. (*Acustica*, 1953, Vol. 3, No. 6, pp. 370–374.)

534.2-13 **1632**

Combined Translational and Relaxational Dispersion of Sound in Gases.—M. Greenspan. (*J. acoust. Soc. Amer.*, Jan. 1954, Vol. 26, No. 1, pp. 70–73.)

534.2-14 **1633**

Wave Propagation in a Randomly Inhomogeneous Medium: Part 2.—D. Mintzer. (*J. acoust. Soc. Amer.*, Nov. 1953, Vol. 25, No. 6, pp. 1107–1111.) The region of validity of the single-scattering approximation used in part 1 (931 of April) is found by considering the next higher approximation. Some results are given for the case where the sound wavelength is large compared with the size of the inhomogeneity.

534.213.4 : 534.833.1 **1634**

Transmission of Sound through a Stretched Membrane.—U. Ingard. (*J. acoust. Soc. Amer.*, Jan. 1954, Vol. 26, No. 1, pp. 99–101.) Analysis is given for a system comprising a membrane stretched across a tube. Conditions at resonance and antiresonance are studied by means of equivalent electrical circuits. Measurements made with a tube of diameter 3 in. and a fundamental frequency of 300 c/s gave results in agreement with the theory.

534.213.4-13 **1635**

The Attenuation of Sound in Small Tubes.—G. T. Kemp & A. W. Nolle. (*J. acoust. Soc. Amer.*, Nov. 1953, Vol. 25, No. 6, pp. 1083–1086.) Report of measurements over the frequency range 3·8–20 kc/s, using air-filled tubes of internal radius 0·238 and 0·0292 cm respectively. The results are compared with values calculated from the Kirchhoff theory.

534.231 **1636**

Mean Force on a Sphere in a Spherical Sound Field: Part 1 (Theoretical).—T. F. W. Embleton. (*J. acoust. Soc. Amer.*, Jan. 1954, Vol. 26, No. 1, pp. 40–45.) Theory developed by King (*Proc. roy. Soc. A*, 1934, Vol. 147, pp. 212–240) is presented in a form suitable for calculating the radiation force on a sphere in the field of a progressive spherical wave. The analysis is valid for all values of the ratio of wavelength to sphere radius. For large distances from the source the force is a repulsion varying as the inverse square of the distance. As the source is approached the force becomes an attraction, at a point depending on the frequency and on the sphere radius.

534.231 : 534.6 **1637**

Mean Force on a Sphere in a Spherical Sound Field: Part 2 (Experimental).—T. F. W. Embleton. (*J. acoust. Soc. Amer.*, Jan. 1954, Vol. 26, No. 1, pp. 46–50.) Measurements were made of the deflection of hollow glass spheres, of radius 0·228–3·029 cm, suspended by fine glass fibres in the field of a progressive sound wave, using frequencies between 300 and 7 000 c/s. Results give values of the force on the sphere in good agreement with values derived from the theory in part 1 (1636 above).

534.232 : 534.321.9 : 538.652 **1638**

Investigations on Magnetostrictive Oscillators at Frequencies between 80 and 500 kc/s.—G. Steinkamp. (*Acustica*, 1953, Vol. 3, No. 6, pp. 399–404. In German.) Measurements of the electromechanical and the mechano-acoustic efficiencies of five oscillators were made, from which the electroacoustic efficiency was deduced. Hysteresis and eddy-current losses were also determined. The losses due to internal magnetization processes are discussed in detail.

534.321.9 : 534.22.094.1 **1639**

Modulation Method of Measurement of Ultrasonic Dispersion.—V. A. Zverev. (*C. R. Acad. Sci. U.R.S.S.*, 1st Aug. 1953, Vol. 91, No. 4, pp. 791–794. In Russian.) The method was used in the experimental determination of dispersion in a long Ni wire, using a 1-Mc/s ultrasonic wave modulated at 100 kc/s. Fractional differences of velocity down to $\sim 2{\cdot}4 \times 10^{-3}$ were readily observed.

534.321.9 : 534.23 **1640**

Scattering of Underwater Plane Ultrasonic Waves by Liquid Cylindrical Obstacles.—S. J. Bezuszka. (*J. acoust. Soc. Amer.*, Nov. 1953, Vol. 25, No. 6, pp. 1090–1095.) Report of a theoretical investigation.

534.321.9-14 **1641**

Ultrasonic Transmission through Porous Bodies in Liquids.—G. Schmid & H. Knapp. (*Z. angew. Phys.*, Dec. 1953, Vol. 5, No. 12, pp. 463–472.) Report of measurements at 350 kc/s, using clay diaphragms in a N/1000 KCl solution.

534.373 : 534.213 **1642**

Boundary-Layer Absorption in a Spherical Resonator.—I. D. Campbell. (*Acustica*, 1953, Vol. 3, No. 6, pp. 395–398.) Calculation of the effective wall admittances representing viscous and thermal losses at the boundary leads to a solution of the decay of symmetrical modes of oscillation of a gas within a closed spherical resonator. A numerical example is calculated which permits assessment of the relative amounts of the absorption due to viscosity and thermal conductivity.

534.373 : 534.414 **1643**

A Study of the Factors influencing the Damping of an Acoustical Cavity Resonator.—R. F. Lambert. (*J. acoust. Soc. Amer.*, Nov. 1953, Vol. 25, No. 6, pp. 1068–1083.) Absorption measurements were made using a transverse-particle-velocity pickup device [1057 of 1950 (Hartig & Lambert)]. The results indicate that mechanical losses due to wall vibrations are experimentally significant. Empirical formulae are derived for the relaxation time of air molecules.

534.414 **1644**

On the Theory and Design of Acoustic Resonators.—U. Ingard. (*J. acoust. Soc. Amer.*, Nov. 1953, Vol. 25, No. 6, pp. 1037–1061.) Absorption and scattering from resonators in a free field and in walls are discussed. The effect on the resonance frequency of different aperture geometries is investigated. Design charts are presented for obtaining maximum resonance absorption, taking account of viscosity, heat conduction and radiation.

534.414 : 534.231 **1645**

The Near Field of a Helmholtz Resonator Exposed to a Plane Wave.—U. Ingard. (*J. acoust. Soc. Amer.*, Nov. 1953, Vol. 25, No. 6, pp. 1062–1067.) Calculated values for the near field of a spherical resonator, assuming a uniform velocity distribution in the aperture, are in good agreement with measured values. The case of a resonator at the end of a tube is also discussed.

534.614-14 **1646**

Measurement of the Velocity of Sound in the Ocean.—R. K. Brown. (*J. acoust. Soc. Amer.*, Jan. 1954, Vol. 26, No. 1, pp. 64–67.) An arrangement providing a continuous record of sound velocity as a function of depth is described. A phase-comparison principle is used; the operating frequency is 500 kc/s.

534.614-14 **1647**

Velocity of Sound in Glycerol.—F. A. A. Fergusson, E. W. Guptill & A. D. MacDonald. (*J. acoust. Soc. Amer.*, Jan. 1954, Vol. 26, No. 1, pp. 67–69.) A method for measuring the velocity of sound in liquids is based on the principle of a method used to determine critical angle in optics. The liquid is placed in a thin-walled cell which is rotated in a tank of a second liquid for which the velocity of sound is known. The value obtained for glycerol at 25°C is 1 964 ± 10 m/s at a frequency of 7·5 Mc/s. Values for glycerol-water mixtures are also reported.

534.614-14 **1648**

A Method of Measuring the Velocity of Sound in a Few Grams of a Liquid.—J. H. Janssen. (*Acustica*, 1953, Vol. 3, No. 6, pp. 391–394.) A slight modification of the e.m. sound generator of St. Clair (2455 of 1941) permits the determination of the resonance frequency of a bar clamped at its centre, with and without a liquid column on top of it. The velocity of sound in the liquid can then be calculated.

534.614-14 : 534.321.9 **1649**

The Measurement of the Velocity of Sound in Liquids.—G. M. Graham. (*J. acoust. Soc. Amer.*, Nov. 1953, Vol. 25, No. 6, pp. 1124–1127.) A technique suitable for use in the frequency range 0·5–5 Mc/s is described. Measurements on distilled water are reported.

534.64 **1650**

The Acoustic Impedance of a Porous Layer at Oblique Incidence.—J. S. Pyett. (*Acustica*, 1953, Vol. 3, No. 6, pp. 375–382.) The specific normal impedance of a layer of anisotropic porous material for a plane wave incident in any direction is calculated in terms of the two propagation parameters of the material, on the assumption that one of the principal axes of the material is normal to the surface. Experiments on the same lines as those of Shaw (302 and 303 of February) gave results for rockwool in agreement with calculations.

534.76 **1651**

Basic Principles of Stereophonic Sound.—W. B. Snow. (*J. Soc. Mot. Pict. Telev. Engrs*, Nov. 1953, Vol. 61, No. 5, pp. 567–587. Discussion, pp. 587–589.) A review of published theory, with examples of practical applications. 68 references.

534.79 **1652**

A Technique and a Scale for Loudness Measurement.—W. R. Garner. (*J. acoust. Soc. Amer.*, Jan. 1954, Vol. 26, No. 1, pp. 73–88.) A true ratio scale of loudness is obtained by interrelating two scales derived from judgments made on two different principles, namely (*a*) equisection judgments, in which the observer adjusts a series of tones between two fixed limits to give a series of equal loudness intervals, and (*b*) fractionation judgments, in which the observer is instructed to adjust a tone to obtain a specified fraction of the initial loudness. Results of experiments indicate the validity of the assumptions made.

534.79 **1653**

Theory of Loudness Level and Loudness Sensation.—G. Quietzsch. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 9/10, pp. 169–177.) A summarized account of recent work on loudness level and loudness sensation with particular reference to the relation between the phon and sone scales.

534.833 **1654**

Electronic Sound Absorber.—H. F. Olson & E. G. May. (*J. acoust. Soc. Amer.*, Nov. 1953, Vol. 25, No. 6, pp. 1130–1136.) A microphone, amplifier and loudspeaker are arranged in a feedback system so as to reduce the sound pressure near the microphone. Reductions of 10–25 db can be achieved over a three-octave range at low audio frequencies. A suitable microphone is the electronic type previously described [3413 of 1947 (Olson)].

534.833 **1655**

Measurement of Sound Absorption Coefficients at the Research Centre for Cinematography in Rome.—G. Parolini. (*Ann. Télécommun.*, Dec. 1953, Vol. 8, No. 12, pp. 391–394.) Measurements were made with warble tones in a reverberation chamber. Results for 31 types of sound-absorbent materials of Italian manufacture, and for costumes of various periods, are tabulated.

534.834 : 534.861.1 **1656**

Acoustical Measurements on Components of Air-Conditioning Installations for Broadcasting and Television Studios.—G. Venzke. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 11/12, pp. 224–231.)

534.84 **1657**

An Empirical Acoustic Criterion.—T. Somerville. (*Acustica*, 1953, Vol. 3, No. 6, pp. 365–369.) A parameter R has been evolved which expresses the divergence of the reverberation-time/frequency characteristic from the mean reverberation time T_m. A parameter D has also been evolved which is a measure of the general decay irregularity for the studio under test. When $(D + 0{\cdot}7\ R)$ is plotted against T_m, the points representing studios and halls subjectively classified as having good acoustic properties are all found to lie within a particular area.

534.85 **1658**

Reduction of Background Noise in the Reproduction of Gramophone Disk Records.—M. J. de Cadenet. (*Rev. Son*, Dec. 1953, No. 9, pp. 311–322.) A review of basic circuits for use particularly with modern microgroove records.

621.395.61 **1659**

An Acoustic Lens as a Directional Microphone.—M. A. Clark. (*J. acoust. Soc. Amer.*, Nov. 1953, Vol. 25, No. 6, pp. 1152–1153.) Discussion of the radiation pattern of a microphone in which the transducer is located at or near the focus of a lens, e.g. of slant-plate type, the two being joined by a conical horn.

621.395.623.7 **1660**

A Physical Approach to the Generalized Loudspeaker Problem.—O. K. Mawardi. (*J. acoust. Soc. Amer.*, Jan. 1954, Vol. 26, No. 1, pp. 1–14.) The problem formulated by Foldy & Primakoff (264 of 1946) is studied and an expression is derived relating the sound pressure at a point in the field to the electrical signal at the loudspeaker terminals, a transfer function being defined by analogy with the methods of network analysis. For the simple case of a circular loudspeaker mounted in an infinite baffle, the integral equation obtained is solved exactly.

621.395.625 (083.74) **1661**

I.R.E. Standards on Sound Recording and Reproducing: Methods for Determining Flutter Content, 1953.—(*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 537–541.) Standard 53 I.R.E. 19S2.

621.395.625.3 **1662**

Accurate Measurement of the Speed of Transport of Magnetic Tapes.—F. Gallet. (*Rev. Son*, Oct. 1953, No. 7, pp. 252–255.) The mains voltage is recorded on a length of the tape under test, and the magnetic-spectrum method is applied to locate the positions of the alternations. The length of tape occupied by 100 alternations gives the speed that would be obtained with a constant mains frequency of 50 c/s. An alternative method for continuous measurements is mentioned.

621.395.625.6 : 537.228.3 **1663**

Electro-Optic Sound-on-Film Modulator.—R. O'B. Carpenter. (*J. acoust. Soc. Amer.*, Nov. 1953, Vol. 25, No. 6, pp. 1145–1148.) Description of a variable-density sound-recording system using a crystal modulator of the type described previously [2209 of 1953 (Dressler & Chesnes)].

621.395.92 **1664**

Recent Advances in Hearing Aids.—L. G. Hector, H. A. Pearson, N. J. Dean & R. W. Carlisle. (*J. acoust. Soc. Amer.*, Nov. 1953, Vol. 25, No. 6, pp. 1189–1194.) Three models are described; the output powers are about 1, 5 and 40 mW respectively.

AERIALS AND TRANSMISSION LINES

621.372.2 **1665**

Experimental Study of the Transmission of Centimetre Waves along Wire Waveguides.—P. Chavance & B. Chiron. (*Ann. Télécommun.*, Nov. 1953, Vol. 8, No. 11, pp. 367–378.) Measurements over the frequency range 3–10 kMc/s are reported; six different polyethylene-covered Cu wires were used. Various types of launching device are described. Results indicate that the greater the reduction of phase velocity, the greater is the concentration of energy round the guide; the degree of concentration increases with the thickness of the dielectric coating. Discontinuities give rise to both reflection and radiation. Rain caused attenuations of 3–7 db/100 m at 3·15 kMc/s; a film of soot produced an attenuation of only 1·5 db/100 m. A power of 250 kW was transmitted without complications. Possible applications are discussed.

621.372.2 **1666**

Attenuation and Power-Handling Capability of Helical Radio-Frequency Lines.—J. H. Bryant & E. J. White. (*Trans. Inst. Radio Engrs*, Nov. 1953, Vol. MTT-1, No. 2, pp. 33–36.) A method is given for calculating the cold insertion loss and the power-handling capacity of a helical line with or without an outer coaxial cylindrical conductor.

621.372.2 + 535.41] : 621.3.012 **1667**

On a Property of a Family of Equiangular Spirals and its Application to Some Problems of Wave Propagation.—K. Landecker. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, pp. 41–48.) The locus of all end points of the normals drawn from a point in a plane to the members of a family of equiangular spirals is a circle. The standing-wave pattern in a uniformly attenuating medium may, in simple cases, be represented by a vector diagram using a symmetrical pair of spirals. Construction of the locus circle enables the voltage and current maxima and minima to be determined. Transmission-line and light-wave interference examples are given, and the application in conjunction with a Smith chart is indicated.

621.372.2 : 621.315.212 : 621.317.733 **1668**

Some Steady-State Characteristics of Short Irregular Lines.—A. Rosen. (*Electronic Engng*, March 1954, Vol. 26, No. 313, pp. 90–96.) Analysis is based on representation of the distribution of impedance irregularities by a Fourier series. Measurements of impedance and of attenuation coefficient are discussed. A description is given of a bridge with variable-capacitance ratio arms for testing factory lengths of coaxial cable. See also 1295 of May.

621.372.21.029.6 **1669**

Low-Loss Microwave Line.—F. J. Tischer. (*Arch. elekt. Übertragung*, Dec. 1953, Vol. 7, No. 12, pp. 592–596.) Analysis of wave propagation along a line consisting of parallel strip conductors and a dielectric cross-bar. The transverse magnetic field parallel to the conductors is zero, hence no induced electric currents flow along the strips. Sections can therefore be coupled directly. The attenuation/wavelength characteristics of the line are compared with those of rectangular and circular waveguides.

621.372.8 **1670**

Propagation of Microwaves through a Cylindrical Metallic Guide Filled Coaxially with Two Different Dielectrics: Part 2.—S. K. Chatterjee. (*J. Indian Inst. Sci.*, Section B, July 1953, Vol. 35, No. 3, pp. 103–117.) The field components and propagation characteristics for the TM mode are derived. The hollow waveguide is treated as a special case. Part 1: 328 of February.

621.372.8 **1671**

Propagation of Microwaves through a Cylindrical Metallic Guide Filled Coaxially with Two Different Dielectrics: Part 3.—S. K. Chatterjee. (*J. Indian Inst. Sci.*)

Section B, Oct. 1953, Vol. 35, No. 4, pp. 149–169.) The propagation characteristics for the TE_{01} and TM_{11} modes are derived. The results indicate that the phase velocity for a given mode can be adjusted to a pre-assigned value by a suitable choice of the dielectric constants and radii of the two media. In the case of the TE_{01} mode most of the energy is located in the medium having the higher dielectric constant. Part 2: 1670 above.

621.372.8 **1672**

Annular Resonant Slots in Dielectric-Filled Circular Waveguide.—M. Cohn. (*Trans. Inst. Radio Engrs*, Nov. 1953, Vol. MTT-1, No. 2, pp. 39–44.) The variation of susceptance with frequency over the range 8·2–9·6 kMc/s was investigated experimentally for irises with annular slots of various dimensions, in polystyrene-filled waveguides operating in the TE_{11} mode. Relations between the resonance frequency and Q value and the slot dimensions are derived. Results are shown in graphs.

621.372.8 **1673**

Graphical Analysis of Measurements on Multiport Waveguide Junctions.—S. Stein. (*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, p. 599.) Extension of previous work [3191 of 1953 (Storer et al.)].

621.372.8 **1674**

On the Propagation Constant in Gentle Circular Bends in Rectangular Wave Guides—Matrix Theory.—A. T. de Hoop. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, p. 136.) Correction to paper noted in 968 of April.

621.396.67.012.12 : 517.864 **1675**

Solution of the Integral Equation of a Linear Aerial.—L. D. Bakhrakh. (*C. R. Acad. Sci. U.R.S.S.*, 1st Oct. 1953, Vol. 92, No. 4, pp. 755–758. In Russian.) The radiation-pattern function is related to the aerial current by a Fredholm-type equation of the first kind. The conditions are derived for the solutions to be in the form of (*a*) a finite sum of Mathieu harmonics and (*b*) a convergent series of Mathieu functions. The solution can be extended to the case of a plane aerial.

621.396.67.029.62 : 621.397 **1676**

Band III Television Aerials.—F. R. W. Strafford. (*Wireless World*, April 1954, Vol. 60, No. 4, pp. 181–184.) Requirements of aerials for receiving the proposed British transmissions in band III are discussed on the basis of the known performance of band-I aerials.

621.396.673.029.51 **1677**

Design and Adjustment of the Aerial at the National Long-Wave Station [at Allouis].—R. Chaste. (*Ann. Radioélect.*, Oct. 1953, Vol. 8, No. 34, pp. 301–312.) Design details are given of the folded $\lambda/4$ vertical aerial operating on 164 kc/s with bandwidth 20 kc/s [886 of March (Gaillard)]. Preliminary measurements were made on a model, scale 1 : 170.

621.396.674.3 **1678**

The Dipole and its Radiation.—A. Spork. (*Elektrotech. u. Maschinenb.*, 15th Dec. 1953, Vol. 70, No. 24, pp. 545–554.) Theory introductory to a series of papers on aerials is presented.

621.396.674.33 **1679**

The Symmetrical Biconical Aerial with Arbitrary Cone Angle.—L. Robin & A. Pereira-Gomes. (*Ann. Télécommun.*, Dec. 1953, Vol. 8, No. 12, pp. 382–390.) Schelkunoff's method (1049 of 1942) is extended to the general case, with the semi-angle of the cone, ψ, having any value in the range $0 < \psi < \pi/2$. Numerical computations are made for $\psi = 15°$, $30°$, $45°$, $60°$ and $75°$. The corresponding normalized impedances at the end and at the centre of the dipole are then calculated, taking into account the first two complementary internal waves and the first three external waves, in addition to the principal waves. Results are shown graphically.

621.396.676.012.12 **1680**

Electrically Small Antennas and the Low-Frequency Aircraft Antenna Problem.—J. T. Bolljahn & R. F. Reese. (*Trans. Inst. Radio Engrs*, Oct. 1953, Vol. AP-1, No. 2, pp. 46–54.) Quasi-static measurement techniques suitable for the determination of the radiation pattern and receiving sensitivity of electrically small aerials of both the electric- and magnetic-dipole types are described. These involve measurements on models in an electrostatic cage or an electrolyte tank. The theory, applications and limitations of these methods are discussed.

621.396.677 **1681**

A Simplified Calculation for Dolph-Tchebycheff Arrays.—G. J. van der Maas. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, pp. 121–124.) A fuller account of work previously reported (634 of March).

621.396.677.3 **1682**

A Four-Terminal Network Theory for the Multi-Elements-Beam-Array with Reflector. (On an Adjustment Method of the Reflector and the Tailwire).—K. Nagai, R. Sato & G. Sato. (*Technol. Rep. Tohoku Univ.*, 1953, Vol. 17, No. 2, pp. 131–147.) The aerial array is treated as a four-terminal network with input terminals at the feed points of the energized element and output terminals at the junction of the reflector and stub (tailwire), the stub being considered as a load. From the equations obtained, the array characteristics and the optimum stub length are calculated. Fair agreement with experimental values is obtained.

621.396.677.3.012.12 **1683**

Radiation Pattern Synthesis.—E. A. Laport. (*RCA Rev.*, Dec. 1953, Vol. 14, No. 4, pp. 533–545.) A computational method is described for the synthesis of radiating arrays having zero radiation in specified directions. An extension of this method includes the solutions for radiation patterns from uniform current sheets of any specified aperture. Examples of radiation pattern shaping by using various primary arrays together with various secondary arrays are given.

621.396.677.7 **1684**

Passive Radiating Systems in Waveguides.—M. L. Levin. (*C. R. Acad. Sci. U.R.S.S.*, 1st Aug. 1953, Vol. 91, No. 4, pp. 807–810. In Russian.) A generalization of results obtained earlier for the characteristics of radiation from a resonant slot in a waveguide. The generalization includes the case of an arbitrary non-resonant radiating system consisting of passive metal aerials and slots in waveguide walls.

621.396.677.85 **1685**

Propagation in an Artificial Dielectric.—R. Fortet. (*Ann. Télécommun.*, Nov. 1953, Vol. 8, No. 11, pp. 361–366.) Periodic structures of the type used for microwave lenses are considered, comprising 'free zones', which are dielectrically homogeneous, alternating with regions in which the dielectric material is partitioned by metal strips into 'restricted zones'. The simple case studied by Brillouin (1584 of 1949) is examined and a more generalized theory is developed.

AUTOMATIC COMPUTERS

681.142 : [551.510.3 : 535.325 **1686**

An Analogue Computer for the Solution of the Radio Refractive-Index Equation.—Johnson. (See 1760.)

681.142 : 621.385.832 **1687**

Automatic Beam Current Stabilization for Williams Tube Memories.—R. J. Klein. (*Trans. Inst. Radio Engrs*, Dec. 1953, Vol. EC-2, No. 4, pp. 8–11.) One of the storage points in the memory tube is used as a test point. At regular intervals this is cleared and recharged, and the output is sampled, the beam current being adjusted to keep the sampled output at a constant level. The whole operation takes 40 μs to complete. Circuit details are given.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.011.21 **1688**

A Note on calculating the Total Impedance of Impedors connected in Parallel.—W. Boesch. (*Frequenz*, Nov. 1953, Vol. 7, No. 11, pp. 331–335.) Three methods, one involving use of a desk calculating machine, and another use of a linear nomogram, are compared and contrasted from the point of view of speed and accuracy.

621.3.018.783 : 621.376.3 **1689**

Nonlinear Distortion of a Random Signal. Application to Frequency Modulation.—P. J. M. Clavier. (*Câbles & Transm.*, Oct. 1953, Vol. 7, No. 4, pp. 293–300.) Analysis is based on the instantaneous statistical properties of a random signal, the energy spectrum for a given bandwidth being determined from the appropriate correlation functions. Application of the method is illustrated in the case of f.m. when propagation time is considered. Since the calculation takes account of intermodulation products over a complete frequency band the method has advantages over that based on intermodulation of discrete frequencies.

621.314.22.018.75 : 538.221 : 621.318.1 **1690**

Pulse Permeability and Losses in Magnetic Materials subjected to Rectangular D.C. Pulses.—Einsele. (See 1826.)

621.318.435.3 : 621.375.3 **1691**

Transductor with High-Impedance Control-Winding Termination.—W. Schmidt. (*Arch. elekt. Übertragung*, Dec. 1953, Vol. 7, No. 12, pp. 574–578.) The dynamic behaviour of this transductor is represented by equations similar to those for a transductor with a low-impedance control-winding termination (2579 of 1953).

621.372 : 512.831 **1692**

Matrix Analysis of Linear Time-Varying Circuits.—L. A. Pipes. (*Trans. Inst. Radio Engrs*, Dec. 1953, No. PGCT-2, pp. 91–105.)

621.372 + 621.3.018.78] (083.74) **1693**

I.R.E. Standards on Circuits: Definitions of Terms in the Field of Linear Varying Parameter and Nonlinear Circuits, 1953.—(*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 554–555.) Standard 53 I.R.E. 4S1.

621.372.029.63/.64 : 621.315.212 **1694**

A Coaxial Magic-T.—T. Morita & L. S. Sheingold. (*Trans. Inst. Radio Engrs*, Nov. 1953, Vol. MTT-1, No. 2, pp. 17–23.) The basic design consists of a coaxial-line T junction including a shielded loop whose axis is located at the centre of the T; the operation is similar to that of the hybrid coil or the waveguide magic T. Two modifications are described, one using direct coupling between the loop and the loads. Standing-wave characteristics of experimental models for operation at wavelengths of about 10 cm are given; a s.w.r. < 2 can be obtained over a frequency band of about 10%. Application to phase measurements is described briefly.

621.372.221 : 621.385.029.63/.64 **1695**

Filter-Helix Traveling-Wave Tube: Part 1—The Filter Helix, a New Circuit Element for Traveling-Wave Amplifiers and Oscillators.—Dodds & Peter. (See 1963.)

621.372.412 **1696**

The Properties and Manufacture of Piezoelectric Quartz Crystals.—H. L. Downing. (*J. Brit. Instn Radio Engrs*, March 1954, Vol. 14, No. 3, pp. 130–138.) Reprint. See 667 of March.

621.372.412 : 534.133 **1697**

Thickness-Shear and Flexural Vibrations of Contoured Crystal Plates.—R. D. Mindlin & M. Forray. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, pp. 12–20.) Equations of motion expressing approximately and separately the thickness-shear and flexural modes are derived from data on the coupled modes for a plate of uniform thickness [1861 of 1951 and 2156 of 1952 (Mindlin)]. These equations are applied to the case of (*a*) a plate of double-wedge shape, and (*b*) a plate with bevelled edges. Results support the finding that thickness-shear motion is localized at the centre, flexural motion at the edges.

621.372.412 : 534.133 **1698**

Thickness-Shear Vibrations of Piezoelectric Crystal Plates with Incomplete Electrodes.—R. D. Mindlin & H. Deresiewicz. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, pp. 21–24.) The method developed in 1697 above (Mindlin & Forray) is applied to determine the influence of electrode length on thickness-shear frequencies. For a partially coated crystal these frequencies depend on the coupling between the coated and uncoated portions considered as separate systems.

621.372.412 : 534.133 **1699**

Suppression of Overtones of Thickness-Shear and Flexural Vibrations of Crystal Plates.—R. D. Mindlin & H. Deresiewicz. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, pp. 25–27.) Analysis showing how electrodes coated on the surfaces of thickness-shear plates may be shaped so that only one resonance mode is excited.

621.372.413 **1700**

Derivation of Equivalence Theorem of a Weakly Coupled Electromagnetic Cavity-Resonator System.—E. Ledinegg & P. Urban. (*Arch. elekt. Übertragung*, Dec. 1953, Vol. 7, No. 12, pp. 561–568.) A general proof of the equivalence between a system of weakly coupled cavities and a system of coupled resonant LCR circuits is derived from Maxwell's equations by means of a first-order perturbation calculation. The frequency dependence of the system is deduced from the equation of state. The case of two coupled cavity resonators is considered in an example.

621.372.413 **1701**

Calculation of the Resonant Properties of Electrical Cavities.—S. Bertram. (*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 579–585.) The method described is based on measurements made on a model in an electrolyte tank. Calculated values of resonance wavelength and Q are in good agreement with directly measured values.

621.372.414 : 517.5 **1702**

Characteristic Functions of Real Resonators.—V. M. Vakhmin. (*C. R. Acad. Sci. U.R.S.S.*, 1st Aug. 1953, Vol. 91, No. 4, pp. 779–782. In Russian.) Orthogonal characteristic functions for a piecewise-inhomogeneous, one-dimensional system are considered in relation to resonators with energy losses at the boundaries. The analysis provides an explanation of previously published experimental results.

621.372.5 **1703**

An Iterative Method for Network Synthesis.—R. E. Scott & R. L. Blanchard. (*Trans. Inst. Radio Engrs*, Dec. 1953, No. PGCT-2, pp. 19–29.) The numerical method described is based on the complex critical frequencies of the insertion-loss function. Applications to networks with up to four poles and four zeros and to a crystal filter are illustrated.

621.372.5 **1704**

Synthesis of Transfer Functions with Poles Restricted to the Negative Real Axis.—A. D. Fialkow & I. Gerst : L. Weinberg. (*J. appl. Phys.*, Dec. 1953, Vol. 24, No. 12, pp. 1525–1527.) Comment on 1929 of 1953 and author's reply.

621.372.5 : 621.396 **1705**

Radio-Frequency Phase-Difference Networks: a New Approach to Polyphase Selectivity.—Cifuentes & Villard. (See 1910.)

621.372.5.018.78 **1706**

Quasi-Distortionless Filter Functions.—J. L. Stewart. (*Trans. Inst. Radio Engrs*, Dec. 1953, No. PGCT-2, pp. 39–54.) The quasi-distortionless filter network function is specified by expressing the input and output functions as time power series and equating their coefficients. Such filter functions are derived and discussed.

621.372.54 **1707**

The Direct Method of Filter and Delay Line Synthesis.—M. J. E. Golay. (*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 585–588.) Extension of previous work (1497 of 1946). "The direct method consists in postulating an indefinitely recurring network in which each recurring element is coupled to all elements of the network, and in determining the values of these elements and of their indefinitely extended couplings which will yield the exact phase characteristics desired within the exact pass band desired." Examples are given of the application of the method to the design of ideal band-pass filters.

621.372.54 **1708**

The Synthesis of Reactance Networks consisting only of Rejector Circuits in Series, by the Method of Partial Networks.—T. O'Callaghan. (*Frequenz*, Oct. 1953, Vol. 7, No. 10, pp. 299–306.) The modification required in a filter network with given resonance and anti-resonance frequencies in order to introduce a further prescribed resonance or antiresonance frequency is determined. Numerical examples illustrate the method, which is also applied to the reduction of the number of resonance frequencies and to a mechanical oscillator.

621.372.54 **1709**

The Historical Development of Filter Theories.—W. Klein. (*Frequenz*, Nov. 1953, Vol. 7, No. 11, pp. 326–331.)

621.372.54 **1710**

Elementary Ladder-Type Filters.—J. Oswald. (*Câbles & Transm.*, Oct. 1953, Vol. 7, No. 4, pp. 325–358.) A system of classification of conventional ladder-type filters based on image parameters is described. An elementary filter is defined as a network with two prescribed image impedances and minimum attenuation. These are generally composed of conventional half-sections, but in certain cases, particularly for band-pass filters, synthesis involves sections with three branched impedances which cannot be resolved into matched half-sections. Formulae with examples of networks for low-pass, high-pass, band-pass and band-stop filters are given in an appendix.

621.372.54 : 621.314.7 **1711**

***RC* Active Filters.**—J. G. Linvill. (*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 555–564.) A type of filter is described in which the active element is a negative-impedance converter using transistors (2582 of 1953). The number of capacitors required is only equal to the total number of reactance elements in the corresponding *LC* filter. Theory is given, and tests on low-pass, high-pass and band-pass filters are reported.

621.372.543.2 **1712**

Impedance Transformations in Band-Pass Filters.—T. J. O'Donnell & E. M. Williams. (*Elect. Engng, N.Y.*, Dec. 1953, Vol. 72, No. 12, p. 1105.) Digest of paper to be published in *Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72. The design of band-pass impedance-transforming filters is derived from the equivalence between an asymmetrical band-pass filter and a symmetrical section plus an ideal transformer.

621.372.543.2 : 621.375.221 **1713**

Design of a Simple Band-Pass Amplifier with Approximate Ideal Frequency Characteristics.—W. E. Bradley. (*Trans. Inst. Radio Engrs*, Dec. 1953, No. PGCT-2, pp. 30–38.) The application of the 'pole and zero' method of synthesis is illustrated.

621.372.543.2 : 621.376.3 **1714**

F.M. Transient Response of Band-Pass Circuits.—R. E. McCoy. (*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 574–579.) A general formula is derived for the instantaneous deviation of output frequency resulting from a step change of input frequency. Calculations are presented for large frequency shifts in a single-tuned circuit and for small frequency shifts in amplifiers with various numbers of tuned circuits. For small input steps near the middle of the pass band the transient response is the same for f.m. as for a.m. Stagger tuning gives rise to overshoot, but the extent of this is small if the amount of stagger is no more than enough to provide maximally flat response in the steady state.

621.372.543.29 **1715**

One Design Method of Band-Pass Filter for V.H.F.—K. Nagai, R. Sato & N. Saito. (*Technol. Rep. Tohoku Univ.*, 1953, Vol. 17, No. 2, pp. 120–130.) Design formulae for band-pass filters constructed of two-wire and coaxial cables are derived and numerical examples are given. The theoretical and experimental results are in fair agreement.

621.373 : 513.83 **1716**

'Hereditary' Dynamic Systems with Discontinuities ['à déferlement'].—T. Vogel. (*Ann. Télécommun.*, Nov. 1953, Vol. 8, No. 11, pp. 354–360.) The characteristics distinguishing nonlinear from linear oscillations are examined. A class of dynamic systems termed 'discontinuous' ('à déferlement') is defined; cases are discussed for which Poincaré's topological methods can be used to determine the periodic solutions and the stability. Such systems are included in the larger class of 'hereditary' systems defined by Volterra (i.e. systems whose operation is affected by their previous history). See also 630 of 1952.

621.373.4 **1717**

Single-Stage Phase-Shift Oscillator.—W. Bacon. (*Wireless Engr*, April 1954, Vol. 31, No. 4, pp. 100–104.) A method of design is developed in which the phase-shifting network contains an arbitrary number of *RC* or *CR* cells and the value of the first series impedance is half that of the others. Simple formulae are derived for the network impedance and oscillation frequency.

621.373.5 **1718**

Transistor Oscillators.—H. E. Hollmann. (*Arch. elekt. Übertragung*, Dec. 1953, Vol. 7, No. 12, pp. 585–591.) The self-oscillation conditions and frequency-deviation characteristics of a three-point transistor-oscillator are derived by analogy with the retarding-field oscillator, and a comparison is made with measured characteristics of point-contact and junction-type transistor oscillators. Various circuits are examined from the point of view of suitability of application of the two types of transistor. The discussion is limited to the frequency range below α cut off.

621.375.132.012 **1719**

The Audio-Frequency Negative-Feedback Amplifier as a Filter Circuit.—F. Steiner & I. Riess. (*Öst. Z. Telegr. Teleph. Funk Fernsehtech.*, Nov./Dec. 1953, Vol. 7, Nos. 11/12, pp. 141–147.) A single-stage *RC* feedback amplifier is represented by an equivalent damped parallel *LC* circuit and a locus diagram for amplification is constructed. The method is applied to a two-stage amplifier, an expression analogous to form factor in filter theory being derived in terms of feedback ratio. This is useful for determining the effect of feedback on the frequency characteristic in a.f. amplifier design.

621.375.2 **1720**

Bandpass Amplifiers.—Z. Jelonek & R. S. Sidorowicz. (*Wireless Engr*, April 1954, Vol. 31, No. 4, pp. 84–99.) A design method is presented based on the required overall gain, half-power bandwidth and centre frequency of the pass band. The amplifier considered is composed of a number of identical groups each comprising one or more amplifying stages and having a maximum-flatness frequency response. Conditions for maximum possible gain are found. Regeneration due to anode-grid capacitances is discussed; the amount of distortion introduced into the frequency response is related to a regeneration coefficient α. When α is sufficiently large, oscillations occur. Stability conditions for single-tuned and stagger-tuned amplifiers are derived.

621.375.221 **1721**

Distributed Amplifier Theory.—D. V. Payne. (*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 596–598.) Discussion on 2612 of 1953.

621.375.222.029.3 **1722**

A New Transformerless Amplifier Circuit.—K. Onder. (*J. audio Engng Soc.*, Oct. 1953, Vol. 1, No. 4, pp. 282–286.) Four valves in a bridge circuit are driven in appropriate phase and amplitude so as to deliver equal power to a common load. No d.c. flows through the load; negative feedback is easily applied. A 9-W and an 18-W amplifier are described; response characteristics are flat over the audio range at all levels of operation. The 18-W unit weighs 4 lb 3 oz, including power supply and pre-amplifier.

621.375.3 **1723**

Magnetic Amplifier performs Analytical Operations.—L. A. Finzi & R. A. Mathias. (*Elect. Engng, N.Y.*, Dec. 1953, Vol. 72, No. 12, p. 1097.) Digest of paper to be published in *Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72.

621.395.665 **1724**

Audio Automatic Volume Control Systems.—F. W. Roberts & R. C. Curtis. (*J. audio Engng Soc.*, Oct. 1953, Vol. 1, No. 4, pp. 310–316.) Applications of a.v.c. are noted and various circuits are reviewed. Methods of eliminating audible 'thump' occurring on application of a direct control voltage, of deriving the control voltage, and of reducing time delay are discussed. Measurement techniques are outlined.

621.395.665.1 **1725**

The New Compressor-Expander System of the French Post Office.—M. Lagarde, R. Blondé & R. Derosier. (*Câbles & Transm.*, Oct. 1953, Vol. 7, No. 4, pp. 301–308.) The new unit has improved operating characteristics and is less than one-quarter the size of the former type [306 of 1951 (Lagarde et al.)]. Two Si diodes replace the Cu_2O rectifiers in the potentiometer system, and two Ge diodes the double-diode valve in the detector unit. Other valves are replaced by miniature types. Performance tests are reported.

GENERAL PHYSICS

530.112 **1726**

Proposal for a New Aether Drift Experiment.—H. L. Furth. (*Nature, Lond.*, 9th Jan. 1954, Vol. 173, No. 4393, pp. 80–81.) An experiment using standing microwaves is outlined.

535.1 : 537.228 **1727**

Deductions regarding the Constitution of Light Energy.—J. Stark. (*Z. Phys.*, 17th Nov. 1953, Vol. 136, No. 2, pp. 221–223.) A discussion based on the results of experiments previously reported (1292 of 1953). The field associated with a particle of light, as defined by Planck, is nonoscillatory, the frequency associated with the light being due to the circulation of e.m. energy in the particle.

535.37 : 537.228 **1728**

The Mechanism of Electroluminescence: Part 2—Applications to the Experimental Facts.—D. Curie. (*J. Phys. Radium*, Dec. 1953, Vol. 14, No. 12, pp. 672–686.) Theory previously developed (1373 of May) is used to interpret observed phenomena, including temperature and frequency effects, fluctuations of brightness corresponding to field alternations, initial rise of brightness, and surface effects. Good crystallization, abundance of luminescence centres and donor levels, and absence of other defects are conditions favouring the production of electroluminescence. Various theories of the phenomenon are compared in an appendix.

535.41 + 621.372.2] : 621.3.012 **1729**

On a Property of a Family of Equiangular Spirals and its Application to Some Problems of Wave Propagation.—Landecker. (See 1667.)

535.42 : 538.566 **1730**

The Diffraction of Waves in passing through an Irregular Refracting Medium.—J. A. Fejer. (*Proc. roy. Soc. A*, 22nd Dec. 1953, Vol. 220, No. 1143, pp. 455–471.) "A relation is derived between the angular power spectrum of waves emerging from a thin diffracting screen random in two dimensions and the auto-correlation function describing the irregularities of the field as it emerges from the diffracting screen. The special case of an isotropic screen characterized by an auto-correlation function which depends only on distance and not on direction is discussed for normal and oblique incidence. Multiple scattering of waves caused by volume irregularities of the dielectric constant is considered. The angular power spectrum and the auto-correlation function describing the irregularities of the diffraction field caused by multiple scattering in a thick slab are determined. The results are compared with those obtained by Hewish [1284 of 1952] for a thin phase-changing screen. The results are discussed in terms of problems arising in the study of radio-wave propagation."

537.213 **1731**

A Note on Uniqueness Proofs for Boundary-Value Problems in Potential Theory and Steady Heat Conduction.—M. E. Rayner. (*Quart. J. Mech. appl. Math.*, Dec. 1953, Vol. 6, Part 4, pp. 385–390.) By allowing the boundary to tend to infinity in two directions, and considering the problem in a semi-infinite region, it is possible to prove uniqueness by classical methods for a very large class of boundary conditions.

537.311.5 : 517.9 **1732**

Variational Methods for Problems in Resistance.—J. F. Carlson & T. J. Hendrickson. (*J. appl. Phys.*, Dec. 1953, Vol. 24, No. 12, pp. 1462–1465.) Schwinger's variational methods are used to calculate upper and lower limits for the resistance of a cylinder with a specified transverse distribution of potential at one end.

537.311.62 : 517.392 **1733**

The Evaluation of the Surface Impedance in the Theory of the Anomalous Skin Effect in Metals.—A. N. Gordon & E. H. Sondheimer. (*Appl. sci. Res.*, 1953, Vol. B3, Nos. 4/5, pp. 297–304.) A method is described for obtaining series expansions for the integrals which represent the surface impedance.

537.52 **1734**

Note on the Quantitative Development of the [gas] **Discharge Characteristic.**—E. Pfender. (*Z. angew. Phys.*, Dec. 1953, Vol. 5, No. 12, pp. 450–453.)

537.52 : 551.594.223 **1735**

Investigation of Ball Lightning by means of Models.—H. Nauer. (*Z. angew. Phys.*, Dec. 1953, Vol. 5, No. 12, pp. 441–450.) Experiments with gas discharges are described.

538.2 **1736**

U.S.S.R. Research on Magnetism.—S. Rosenblum. (*Nuovo Cim.*, 1953, Supplement to Vol. 10, No. 4, pp. 441–458. In French.) A brief historical survey with comprehensive bibliography.

538.214 **1737**

Effect of the Surface on the Magnetic Properties of an Electron Gas.—F. S. Ham. (*Phys. Rev.*, 1st Dec. 1953, Vol. 92, No. 5, pp. 1113–1119.) The energy levels of free electrons confined in a finite cylindrical box with a uniform axial magnetic field are computed using the WKB approximation; the form of approximation appropriate to various boundary conditions is discussed. The results are used to calculate the susceptibility of the system.

538.3 **1738**

On Reciprocity Theorems in Electromagnetic Theory.—T. H. Crowley. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, pp. 119–120.) Five different types of sources of e.m. fields are considered, and the corresponding reciprocity theorems stated.

538.3 **1739**

A Scalar Representation of Electromagnetic Fields.—H. S. Green & E. Wolf. (*Proc. phys. Soc.*, 1st Dec. 1953, Vol. 66, No. 408A, pp. 1129–1137.) It is shown that in a region which is free from currents and charges any e.m. field may be rigorously derived from a single, generally complex, scalar wave function. The momentum density and energy density defined in terms of this function differ from those given by the usual expressions, but the differences disappear on integration over any arbitrary macroscopic domain.

538.5 **1740**

Induction of Currents by Moving Charges.—Ya. N. Fel'd. (*C. R. Acad. Sci. U.R.S.S.*, 21st Nov. 1953, Vol. 93, No. 3, pp. 447–450. In Russian.) An analysis is made of the field due to a charge moving between a pair of parallel disk electrodes, connected externally by a conductor. A general expression for the current flowing through the conductor is derived in terms of the electrode radius, r_0, and separation, a, and the velocity of the charge, u. A periodic discharge could be obtained with particular values of r_0, a and u.

538.561 : 662.2 **1741**

Electromagnetic Waves emitted on Detonation of Explosives.—H. Kolsky. (*Nature, Lond.*, 9th Jan. 1954, Vol. 173, No. 4393, p. 77.) Small electrical disturbances, detected incidentally while using explosives to produce sharp stress pulses, were later investigated separately. The effect was displayed on a high-speed c.r.o. The potential of a wire probe reached a maximum after about 50 μs and then decayed to zero. The effect is probably due to the production of positive and negative ions having different mobilities.

538.566 **1742**

Vector Modifications inherent in the Doppler Effect for Waves Propagated in a Dielectric Medium.—M. Risco. (*J. Phys. Radium*, Dec. 1953, Vol. 14, No. 12, pp. 657–662.) The propagation of plane e.m. waves in a moving medium is characterized by four vectors, as compared with two for a stationary medium, because the directions of the electric and magnetic fields no longer coincide with the respective inductions. Relations between these vectors are derived and their physical significance is discussed.

538.566 **1743**

The Electromagnetic Transmission Characteristics of the Two-Dimensional Lattice Medium.—H. S. Bennett. (*J. appl. Phys.*, June 1953, Vol. 24, No. 6, pp. 785–810.) A theoretical investigation is made of systems with obstacles arranged to form a regular lattice in planes perpendicular to the direction of propagation, the obstacles having elliptical cross-section. An examination is made of the influence of obstacle size, shape and spacing, and of the wave polarization on the transmission characteristics. No restriction is introduced as regards the size of the obstacle in relation to λ. The theory is relevant to problems of microwave lenses and transmission circuits of travelling-wave valves.

538.566 : 535.42 **1744**

Microwave Diffraction Measurements in a Parallel-Plate Region.—R. V. Row. (*J. appl. Phys.*, Dec. 1953, Vol. 24, No. 12, pp. 1448–1452.) Diffraction of a plane or a cylindrical wave by wedges, covered with 0·003-in. silver foil, was investigated experimentally by a probe method. The wedge, the 3·185-cm-λ line source and the probe were located between two large parallel duralumin sheets spaced $\frac{1}{2}$-in. apart. The measured values of field strength are compared with values derived from previously published theory.

538.566 : 538.311 **1745**

Radiation from a Line Source Adjacent to a Conducting Half Plane.—J. R. Wait. (*J. appl. Phys.*, Dec. 1953, Vol. 24, No. 12, pp. 1528–1529.) Expressions for the field are obtained in terms of tabulated functions by using an alternative method of analysis to that of Harrington (2967 of 1953).

538.566.2 **1746**

The Fields of a Line Source of Current over a Stratified Conductor.—J. R. Wait. (*Appl. sci. Res.*, 1953, Vol. B3, Nos. 4/5, pp. 279–292.) Expressions for the electric and

the magnetic fields are derived, assuming the wire to be infinitely long and parallel to the conductor. At large distances the results can be generalized to apply to any source of horizontally polarized waves situated on the surface of a half-space consisting of an arbitrary number of layers.

538.569.4.029.64 **1747**

Absorption of Microwaves in Gases.—Krishnaji & P. Swarup. (*J. appl. Phys.*, Dec. 1953, Vol. 24, No. 12, p. 1525.) Absorption coefficients in the 3-cm waveband were determined for ammonia, ethyl alcohol and acetaldehyde at a pressure of 745 mm Hg, and for methyl iodide and acetone at 20 cm Hg and 25 cm Hg, respectively.

539.23 : 537.533.8/.9 **1748**

The Decomposition of Thin Films on Bombardment with Slow Electrons.—D. A. Wright & J. Woods. (*Proc. phys. Soc.*, 1st Dec. 1953, Vol. 66, No. 408B, pp. 1073–1086.) The threshold energies of the bombarding electrons were determined for the onset of electron absorption, decomposition and secondary emission. The films investigated included BaO, $BaCl_2$, $BaSO_4$ and the alkali halides. The experiments were carried out using diode or triode valve systems, with an oxide-coated cathode operated at 400°C as the source of the bombarding electrons.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.5 : 621.396.96 **1749**

Radio Astronomy: Part 3—Radiolocation of Meteors.—W. Dieminger. (*Arch. elekt. Übertragung*, Dec. 1953, Vol. 7, No. 12, pp. 555–560.) A review of measurement techniques and results, with a note on local ionization effects of meteors. Part 2: 1407 of May (Siedentopf).

523.5 : 621.396.96 **1750**

The Effect of Radar Wavelength on Meteor Echo Rate.—V. R. Eshleman. (*Trans. Inst. Radio Engrs*, Oct. 1953, Vol. AP-1, No. 2, pp. 37–42.) Theory is given which includes the effects of high electron density, the linear rate of trail formation, and the initial column radius on the meteor echo power and hence on the number of echoes received. The theories of Lovell & Clegg (2782 of 1948) and others are discussed critically. A comparison with experimental results is made.

523.7 : 550.38 **1751**

A Note on Solar-Terrestrial Relationships.—N. C. Gerson. (*J. atmos. terr. Phys.*, Jan. 1954, Vol. 4, No. 6, pp. 341–342.) Corpuscular emission from the invisible solar disk and deflection of the particles into certain trajectories could account for the lack of correlation between particular solar and geophysical phenomena.

523.746 **1752**

Identification of Sunspots.—H. Alfvén. (*Tellus*, Nov. 1953, Vol. 5, No. 4, pp. 423–445.) Previous work (3104 of 1948) indicates a statistical correlation between spots on opposite hemispheres during successive sunspot cycles. Analysis of sunspots between latitude 4°S and 4°N appears to support this view. A number of sunspots are identified as being produced by the same original disturbance in the solar core; the mechanism is explained on the basis of the magneto-hydrodynamic theory of sunspots.

523.854 : 621.396.822 **1753**

Position and Identification of a Bright Extended Radio Source in Gemini.—J. E. Baldwin & D. W. Dewhirst. (*Nature, Lond.*, 23rd Jan. 1954, Vol. 173, No. 4395, pp. 164–165.) More accurate observations are reported on a previously detected source [121 of 1952 (Ryle et al.)].

523.854 : 621.396.822 **1754**

The Radio Brightness Distributions over Four Discrete Sources of Cosmic Noise.—B. Y. Mills. (*Aust. J. Phys.*, Dec. 1953, Vol. 6, No. 4, pp. 452–470.) The experimentally determined isophotes, obtained from measurements with a variable-aerial-spacing radio interferometer at 101 Mc/s, are compared with the optical features of the nebulae.

523.854 : 621.396.822 **1755**

Galactic Radiation at Radio Frequencies: Part 5—The Sea Interferometer.—J. B. Bolton & O. B. Slee. (*Aust. J. Phys.*, Dec. 1953, Vol. 6, No. 4, pp. 420–433.) The factors governing the interference pattern of a Lloyd's-mirror type of interferometer at frequencies between 40 and 400 Mc/s are discussed and three systems for reducing the effect of background noise are described. Part 4: 1905 of 1952 (Bolton & Westfold).

523.854 : 621.396.822 : 550.510.535 **1756**

Galactic Radiation at Radio Frequencies: Part 6—Low-Altitude Scintillations of the Discrete Sources.—J. G. Bolton, O. B. Slee & G. J. Stanley. (*Aust. J. Phys.*, Dec. 1953, Vol. 6, No. 4, pp. 434–451.) Scintillations of four discrete sources of altitudes from 0° to 10° were observed at frequencies in the range 40 to 300 Mc/s. A strong correlation is established between the occurrence of scintillations and sporadic E. Part 5: 1755 above (Bolton & Slee).

550.385 : 551.55 : 551.510.535 **1757**

Note on Geomagnetic Disturbance as an Atmospheric Phenomenon.—E. H. Vestine. (*J. geophys. Res.*, Dec. 1953, Vol. 58, No. 4, pp. 539–541.) Possible relations between ionospheric winds and atmospheric electric currents associated with magnetic storms are briefly discussed.

550.385 : 551.556 **1758**

The Immediate Source of the Field of Magnetic Storms.—E. H. Vestine. (*J. geophys. Res.*, Dec. 1953, Vol. 58, No. 4, pp. 560–562.) Results of a comparison of mean values of initial phase of magnetic storms at Huancayo, Cheltenham (Md), Honolulu and San Juan (Porto Rico), indicate that major immediate sources of magnetic-field changes during storms in all phases are within or near the atmospheric region. See also 1757 above.

551.510.3 : 535.325 **1759**

A Statistical Survey of Atmospheric Index-of-Refraction Variation.—C. M. Crain, A. W. Straiton & C. E. von Rosenberg. (*Trans. Inst. Radio Engrs*, Oct. 1953, Vol. AP-1, No. 2, pp. 43–46.) Survey of microwave measurements made at heights of 2 000–25 000 ft over the Pacific Ocean, California and Ohio, using an airborne refractometer described by Crain & Deam (3493 of 1952).

551.510.3 : 535.325] : 681.142 **1760**

An Analogue Computer for the Solution of the Radio Refractive-Index Equation.—W. E. Johnson. (*J. Res. nat. Bur. Stand.*, Dec. 1953, Vol. 51, No. 6, pp. 335–342.) A computer in use at the C.R.P.L. comprises basic computation circuits incorporated in a bridge circuit. A 10-turn potentiometer is modified so as to give an approximately exponential variation of the resistance with the shaft rotation, corresponding to the curve of the saturated-water-vapour term in the equation.

551.510.535 **1761**

Irregularities in the Ionosphere.—R. Roy & J. K. D. Verma. (*J. geophys. Res.*, Dec. 1953, Vol. 58, No. 4, pp. 473–485.) Electron clouds in both the E and the F regions have been detected at vertical incidence by means of the equipment described by Banerjee & Roy (1677 of 1953). Photographs of typical echo records are shown; the power and persistence of the echoes are discussed.

551.510.535 **1762**

The Problem of Locating Inhomogeneities in the Ionosphere.—A. A. Gorozhankina. (*C. R. Acad. Sci. U.R.S.S.*, 21st Nov. 1953, Vol. 93, No. 3, pp. 459–461. In Russian.) Vertical soundings were made using two frequencies, $f_1 = 4{\cdot}3$ Mc/s and $f_2 = 6{\cdot}4$ Mc/s, chosen so that f_1 was reflected at the F_1 layer or the lower part of the F_2 layer and f_2 near the middle of the F_2 layer. The correlation factors ρ between pairs of the four parameters defined by $k = (\Delta\overline{R}/\Delta\overline{t})/\overline{R}$, derived from the amplitudes R of the ordinary and the extraordinary f_1 and f_2 signals recorded over periods t of a few minutes, are calculated and their significance is discussed. A high degree of correlation ($\rho > 0{\cdot}9$) between the four parameters indicates that the inhomogeneous region lies in the path common to the f_1 and f_2 signals.

551.510.535 **1763**

Recombination and Diffusion and Spread Echoes from the Ionosphere.—T. L. Eckersley. (*Proc. phys. Soc.*, 1st Dec. 1953, Vol. 66, No. 408B, pp. 1025–1038.) The inclusion of a diffusion term in the differential equation of layer formation, to account for ionization due to the influx of charged particles, leads to a solution in terms of a doubly periodic elliptic function. This solution indicates the possibility of a periodic variation of ionic density within the F layer such as to account for spread echoes which have been observed. Layers produced by ultra-violet radiation are many wavelengths thick, those due to particle ionization are only two or three wavelengths thick and are embedded in the background of ionization. The existence of auroral curtains provides further evidence of ionization by particles.

551.510.535 **1764**

Origin of the E Layer of the Ionosphere.—E. Bauer & Ta-You Wu. (*Phys. Rev.*, 1st Dec. 1953, Vol. 92, No. 5, pp. 1101–1105.) The electron densities for the E and F_1 layers resulting from photo-ionization of molecular and atomic oxygen are calculated on the basis of the work by Moses & Wu on the distribution of O_2 and of O in and above the oxygen dissociation layer (129 of 1952 and 102 of 1953). While the results are in reasonable agreement with observations for the E layer, it is not possible to account for the observed value of recombination coefficient for the F_1 layer by any theory based on processes involving only oxygen atoms and molecules.

551.510.535 **1765**

Method of Determining the True Height of the Ionospheric Layers: Part 2—Application of the Exact Value of the Refractive Index (Ordinary-Ray Case).—E. Argence & M. Mayot. (*J. geophys. Res.*, Dec. 1953, Vol. 58, No. 4, pp. 493–496. In French.) Values obtained using the exact value of the refractive index (Appleton-Hartree) are somewhat higher than those obtained with the approximate formulae used in part I (3290 of 1953).

551.510.535 **1766**

Recombination in the F Layers.—A. L. Stewart. (*Nature, Lond.*, 23rd Jan. 1954, Vol. 173, No. 4395, p. 165.) The mechanism proposed by Banerji (1058 of April) is critically discussed.

551.510.535 : 551.594.12 **1767**

Further Discussion of Kelso's Paper on a Method for Determination of the Distribution of Electron Density in the Ionosphere.—L. Kraus. (*J. geophys. Res.*, Dec. 1953, Vol. 58, No. 4, pp. 551–553.) Comment on 1997 of 1953 (Manning).

551.510.535 : 551.594.5 : 550.384 **1768**

Correlation of Magnetic, Auroral, and Ionospheric Variations at Saskatoon.—J. H. Meek. (*J. geophys. Res.*, Dec. 1953, Vol. 58, No. 4, pp. 445–456.) Analysis of measurements made between December 1951 and April 1952. A connection exists between the maximum elevation of auroral light above the northern horizon and the maximum amplitude of variation of H. Some types of sporadic-E reflecting layers appear more frequently during geomagnetic disturbances.

551.594.223 : 537.52 **1769**

Investigation of Ball Lightning by means of Models.—H. Nauer. (*Z. angew. Phys.*, Dec. 1953, Vol. 5, No. 12, pp. 441–450.) Experiments with gas discharges are described.

551.594.5 : 551.510.535 : 551.55 **1770**

On the Production of Glow Discharges in the Ionosphere by Winds.—O. R. Wulf. (*J. geophys. Res.*, Dec. 1953, Vol. 58, No. 4, pp. 531–538.) A source of excitation of the airglow and aurora may be found in the potential difference generated by zonal ionospheric winds cutting the earth's magnetic field. A return path of current flow or glow discharge in the higher ionosphere appears plausible. See also 3790 of 1945.

551.594.5 + 550.385] : 621.396.96 **1771**

Radio Echoes observed during Aurorae and Geomagnetic Storms using 35 and 74 Mc/s Waves simultaneously.—L. Harang & B. Landmark. (*J. atmos. terr. Phys.*, Jan. 1954, Vol. 4, No. 6, pp. 322–338.) Observations made at Kjeller in 1952 and at Tromsoe during early 1953 are reported. Echoes are only received when the aerial is directed towards the North; the echo amplitude has a maximum value when the aerial is directed horizontally, and decreases rapidly with increased elevation of the aerial. The results indicate that there is no correlation between the position of visible aurorae and echo range but that there is a correlation between the occurrence of high E_s-layer critical frequency and the reception of echoes. During geomagnetic storms echoes on 74 Mc/s are observed only during the more severe phases. Scattering from the ground or sea reflected back via an intense E_s layer is advanced in explanation of the observations.

LOCATION AND AIDS TO NAVIGATION

621.396.932 + 621.396.969.3 **1772**

Radio in the Service of the Seaman.—C. V. Robinson. (*Proc. Instn elect. Engrs*, Part I, Jan. 1954, Vol. 101, No. 127, pp. 27–28.) Chairman's address, I.E.E. Southern Centre. Communications and navigational aids are reviewed.

621.396.96 : 551.578 **1773**

Polarization of Radar Echoes from Meteorological Precipitation.—I. M. Hunter. (*Nature, Lond.*, 23rd Jan. 1954, Vol. 173, No. 4395, pp. 165–166.) A 'circularly polarized' radar for operation on a wavelength of 3·2 cm has been constructed, in which the polarization parameters are accurately known and controlled (voltage ellipticity ratio 0·99 on transmission and 0·95 on reception) and spurious signals due to departure from circularity are eliminated by means of a grating in the

waveguide which separates the incoming signals into two orthogonal components. Error signals can be reduced to a level of −50 db for point targets. Measurements on various types of precipitation are tabulated and discussed.

621.396.968 : 551.578.1 **1774**

Rain Clutter Measurements with C.W. Radar Systems Operating in the 8-mm Wavelength Band.—D. G. Kiely. (*Proc. Instn elect. Engrs*, Part III, March 1954, Vol. 101, No. 70, pp. 101–108.) Measurements were made using (*a*) a single aerial for transmission and reception, with polarization duplexing, and (*b*) separate aerials for transmission and reception, without duplexing. The amplitude of the clutter was given in terms of decibels below valve power level and was plotted against rainfall rate. The clutter was about 35 db greater in case (*a*) than in case (*b*). The maximum useful separation between the centres of the transmission and reception aerials is about 2 ft 6 in. No definite result was obtained for reduction of clutter by use of the orthogonal polarization technique, but the reduction reported by other observers was generally confirmed.

621.396.969.13 **1775**

Height Indicator.—P. H. Leidier. (*Ann. Radioélect.*, Oct. 1953, Vol. 8, No. 34, pp. 313–317.) The principle of operation of the height indicator Type IS 330 is described. It is associated with 10-cm radar equipment Type ER221 measuring azimuth and range. The c.r.o. presentation shows range as abscissa and height relative to the station as ordinate. Sources of error are considered and the accuracy of the system is determined. A block diagram of the unit is given.

MATERIALS AND SUBSIDIARY TECHNIQUES

535.215 : 535.37 **1776**

Effect of Illumination Intensity, Field Strength and Temperature on the Dark Current and Photocurrent of Phosphors.—H. Gobrecht, D. Hahn & H. J. Kösel. (*Z. Phys.*, 8th Dec. 1953, Vol. 136, No. 3, pp. 285–292.) An experimental investigation of various phosphors is reported. The photocurrent increases linearly with the illumination intensity, at low intensities, and exponentially with electric field strength. It increases with temperature without exhibiting saturation in phosphors with a bimolecular luminescence mechanism, but reaches saturation early, or remains constant, in phosphors with a monomolecular mechanism. Results for both photocurrent and dark current are shown graphically.

535.215 : 546.682.231 **1777**

Photoconductivity of Indium Selenide.—D. E. Bode & H. Levinstein. (*J. opt. Soc. Amer.*, Dec. 1953, Vol. 43, No. 12, pp. 1209–1210.) Results are given of measurements of the spectral response of evaporated films at 20°C and −78°C.

535.215 : 546.817.221 **1778**

Photoelectromagnetic and Photoconductive Effects in Lead Sulphide Single Crystals.—T. S. Moss. (*Proc. phys. Soc.*, 1st Dec. 1953, Vol. 66, No. 408B, pp. 993–1002.) Bulk photoeffects have been observed. The quantum efficiency is approximately equal to unity between 0·9 and 2·9 μ, and falls rapidly at 3 μ. The optical activation energy is 0·41 eV. Carrier lifetimes, which are roughly proportional to the square of the resistivity, lie between 6×10^{-10} and 9×10^{-6} sec.

535.215.1 : 537.311.33 **1779**

Sensitization of the Internal Photoeffect in Semiconductors by Chlorophyll and Similar Pigments.—E. K. Putseiko & A. N. Terenin. (*C. R. Acad. Sci. U.R.S.S.*, 21st June 1953, Vol. 90, No. 6, pp. 1005–1008. In Russian.) The spectral response of ZnO is altered by adsorption of chlorophyll so that in addition to the 3 600–3 700 Å maximum, two additional maxima occur in the visible region, near 4 300 Å and between 6 600 and 6 700 Å. Similar results were obtained with other pigments. Other semiconductors investigated include PbO, ZnS, CdS, CdI_2 and PbI_2. The chlorophyll precipitates themselves did not show any photoeffects.

535.37 **1780**

Brightness Waves and Transitory Phenomena in the Quenching of Luminescence by Alternating Electric Fields.—G. Destriau. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, pp. 67–71.) An experimental study was made of the variations of brightness of sulphide phosphors excited by means of a half-wave X-ray generator and subjected to a field alternating at the same frequency (50 c/s) as that of the X-ray generator. Secondary brightness maxima were observed lagging a quarter of a cycle behind the normal X-ray-excited maxima. The amplitude of the secondary maxima varied rapidly from cycle to cycle immediately after application of the field.

535.37 **1781**

Variations in the Decay of Phosphorescence with Frequency of Applied Electric Field.—K. W. Olson. (*Phys. Rev.*, 1st Dec. 1953, Vol. 92, No. 5, p. 1323.) Results of measurements on (Zn, Cd)S-Cu phosphors at 80, 800 and 5 000 c/s are reported.

535.37 **1782**

Mechanism of Impurity Poisoning in the Luminescence of Zinc Sulfide Phosphors with Manganese Activator.—R. H. Bube, S. Larach & R. E. Shrader. (*Phys. Rev.*, 1st Dec. 1953, Vol. 92, No. 5, pp. 1135–1139.) Poisoning effects of Fe, Co and Ni were studied. The relative importance of three possible poisoning mechanisms considered depends on the activator and poison proportions and on the energy of the exciting radiation.

535.37 **1783**

Electroluminescence in Thin Films of ZnS:Mn.—R. E. Halsted & L. R. Koller. (*Phys. Rev.*, 15th Jan. 1954, Vol. 93, No. 2, pp. 349–350.) No luminescence is produced by application of a unidirectional field below breakdown strength, apart from flashes on application and removal of the field. With alternating fields, the brightness varies at a frequency twice that of the applied field. The dependence of the effect on temperature and frequency is investigated.

535.37 **1784**

The Penetration of Electrons into Luminescent Material.—W. Ehrenberg & J. Franks. (*Proc. phys. Soc.*, 1st Dec. 1953, Vol. 66, No. 408B, pp. 1057–1066.) The penetration of electrons of energies between 10 and 40 keV into single crystals of Tl-activated iodides of K, Rb and Cs, and of tungstates of Ca and Cd, and a luminescent plastic, was measured on microphotographs of the luminous region. The diameter of the electron beam was $<0{\cdot}75\ \mu$.

535.37 **1785**

The Manganese Emission in ABF_3 Compounds.—H. A. Klasens, P. Zalm & F. O. Huysman. (*Philips Res. Rep.*, Dec. 1953, Vol. 8, No. 6, pp. 441–451.) Investigation of the fluorescence under cathode-ray excitation of perovskite-type compounds activated with Mn. The A metals used were Na, K, Rb and Cs, the B metals Mg, Zn, Cd, Ca and Sr. A tentative explanation is given of the shift from orange to green occurring with increase of the Mn-F distance.

535.37 **1786**

Electroluminescent Zinc Sulfide Phosphors.—H. H. Homer, R. M. Rulon & K. H. Butler. (*J. electrochem. Soc.*, Dec. 1953, Vol. 100, No. 12, pp. 566–571.) The preparation of phosphors giving blue, green and yellow electroluminescence is described. The activation of the green and blue phosphors is produced by Cu together with Pb, that of the yellow phosphors by Cu with Pb and Mn. A controlled amount of chloride is included in all the phosphors.

535.37 : 537.311.33 **1787**

Electroluminescence of Insulated Particles.—L. Burns. (*J. electrochem. Soc.*, Dec. 1953, Vol. 100, No. 12, pp. 572–579.) An examination is made of possible mechanisms whereby luminescence could be produced in a region on or near the surface of a semiconductor particle embedded in a dielectric and subjected to an electric field. The localization of the field, the presence of electrons in the conduction band, the colour shift with frequency in some phosphors, and the efficiency of the phosphor are discussed.

536.587 : 548.55 : 546.289 **1788**

Temperature Regulator for Germanium Metallurgy.—G. Lehmann & C. Meuleau. (*Onde élect.*, Dec. 1953, Vol. 33, No. 321, pp. 678–683.) The importance of temperature control in the production of single crystals for Ge diodes and triodes is emphasized. In the system described the supply to an induction furnace is controlled by means of a thermometric resistance bridge and a servo motor. The temperature stability achieved is within $\pm\frac{1}{6}$°C at 930°C, for mains voltage variations up to 10%.

537.226 **1789**

Origin of Ferroelectricity in Barium Titanate and other Perovskite-Type Crystals.—H. D. Megaw. (*Acta cryst., Camb.*, 10th Nov. 1952, Vol. 5, Part 6, pp. 739–749.)

537.226.2 : 546.23 **1790**

The Dielectric Constant of Amorphous Selenium at Wavelengths of 1 cm and 3 cm.—Y. Klinger & E. W. Saker. (*Proc. phys. Soc.*, 1st Dec. 1953, Vol. 66, No. 408B, p. 1117.) A cylindrical-cavity resonator operating in the H_{01} mode was used for measurements. The weighted mean value obtained is 6·37$_6$.

537.228.1 : 548.0 **1791**

Dynamic Determination of Elastic and Piezoelectric Coefficients.—R. Bechmann. (*Telefunken Ztg*, Dec. 1953, Vol. 26, No. 102, pp. 353–365.) The determination of the coefficients of piezoelectric crystals from measurements of resonance frequency, crystal dimensions, density and dynamic capacitance is discussed in detail; crystals of various structures are considered.

537.311.31 **1792**

The Propagation of Electrons in a Strained Metallic Lattice.—S. C. Hunter & F. R. N. Nabarro. (*Proc. roy. Soc. A*, 22nd Dec. 1953, Vol. 220, No. 1143, pp. 542–561.) The problem is studied using a perturbation technique in which the perturbing potential is proportional to the elastic strain rather than to the displacement. For the approximation of nearly free electrons, the resulting potential depends only on the Fermi energy of the electrons and not on their interaction with the ionic lattice. In a higher approximation this interaction is taken into account. The method is used to estimate the resistivity produced by dislocations of edge and screw types in Na and Cu.

537.311.31 **1793**

Electrical Conductivity of Metals at High Current Density.—E. S. Borovik. (*C. R. Acad. Sci. U.R.S.S.*, 1st Aug. 1953, Vol. 91, No. 4, pp. 771–774. In Russian.) Measurements were made using both steady currents at very low temperatures and current pulses of densities of the order of 10^6 A/cm² at 20·4° and 78°K. Results indicate that Pt, W and Cu obey Ohm's law at densities up to 5–8 × 10^6 A/cm²; large deviations were found for Bi at 0·5–1 × 10^6 A/cm².

537.311.31 **1794**

The Extra-Resistivity due to Vacancies in Copper, Silver and Gold.—P. Jongenburger. (*Appl. sci. Res.*, 1953, Vol. B3, Nos. 4/5, pp. 237–248.)

537.311.33 **1795**

Some Problems in the Diffusion of Minority Carriers in a Semiconductor.—S. Visvanathan & J. F. Battey. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, pp. 99–102.) "The exact solutions to the problems of the diffusion of minority carriers involved in the measurement of surface recombination velocity in a semiconductor with a sample geometry bounded by two infinite planes are presented. The reduction of the exact solutions to simple forms used in the analysis of experimental data is shown."

537.311.33 **1796**

Contribution to the Theory of Conduction in Semiconductors.—W. H. Isay. (*Ann. Phys., Lpz.*, 15th Dec. 1953, Vol. 13, Nos. 6/8, pp. 327–348.) Given the conductivity rise and decay curves of a CdS crystal, and assuming a three-energy-band model, the various parameters of the associated system of differential equations can be calculated.

537.311.33 **1797**

Effect of Traps on Carrier Injection in Semiconductors.—H. Y. Fan. (*Phys. Rev.*, 15th Dec. 1953, Vol. 92, No. 6, pp. 1424–1428.) Two effects are considered, (*a*) that on photoconductivity, and (*b*) that on the spread of excess carrier concentration under an applied field. Trapped minority carriers, by causing an increase in majority carrier concentration, give rise to increased photoconductivity which may vary nonlinearly with light intensity and have a very long time constant. An expression is derived for the distribution of excess minority carriers as a function of time and space, neglecting diffusion. Results are in agreement with observations.

537.311.33 **1798**

New Semiconducting Compounds: Part 2.—H. Welker. (*Z. Naturf.*, April 1953, Vol. 8a, No. 4, pp. 248–251.) Measurements of conductivity as a function of temperature are reported for specimens of the crystalline compounds InSb, GaSb and AlSb; the widths of the respective forbidden energy bands are determined. Characteristics are shown of the rectifier effect in AlSb, GaSb, GaAs and InP and of the transistor effect in InP. Part I: 1454 of May.

537.311.33 : 539.165 : 621.311.6 **1799**

The Electron-Voltaic Effect in *p-n* Junctions induced by Beta-Particle Bombardment.—P. Rappaport. (*Phys. Rev.*, 1st Jan. 1954, Vol. 93, No. 1, pp. 246–247.) Current/voltage characteristics are shown for Si-alloy wafer-type units bombarded from a 50-millicurie Sr^{90}-Y^{90} source. One of the units has been used as power supply for an a.f. transistor oscillator. The efficiency of conversion of the radioactive power is about 0·4%. Ge units were also investigated.

537.311.33 : 546.23 **1800**

Frequency Dependence of the Electrical Conductivity of Polycrystalline Selenium.—H. Gobrecht & H. Hamisch. (*Z. Phys.*, 17th Nov. 1953, Vol. 136, No. 2, pp. 234–247.) The conductivity of Se layers deposited on glass by

evaporation was measured at frequencies up to 14 Mc/s and at temperatures between −25° and +50°C. The results are shown graphically and are discussed in relation to the Maxwell-Wagner theory for a capacitor with two different dielectrics.

537.311.33 : 546.23 : 548.55 **1801**

Electrical Properties of Selenium: Part 3 — Microcrystalline Selenium Metal Doped.—H. W. Henkels & J. Maczuk. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, pp. 1–11.) Measurements were made on two crystalline forms of pure Se and on samples with small amounts of various metals added. Thermoelectric power and the d.c. and 200-Mc/s resistivities are studied as functions of temperature and a theoretical energy-band model for Se is developed. Part 2: 1335 of 1952 (Henkels).

537.311.33 : [546.28 + 546.289 **1802**

Mobility of Impurity Ions in Germanium and Silicon.—J. C. Severiens & C. S. Fuller. (*Phys. Rev.*, 1st Dec. 1953, Vol. 92, No. 5, pp. 1322–1323.) The diffusion constants of Li in Si and Ge, and of Cu in Ge, as calculated from the experimentally determined mobilities, are in agreement with previously published results.

537.311.33 : [546.28 + 546.289 **1803**

Direct Measurement of the Dielectric Constants of Silicon and Germanium.—W. C. Dunlap, Jr, & R. L. Watters. (*Phys. Rev.*, 15th Dec. 1953, Vol. 92, No. 6, pp. 1396–1397.) Single-crystal Si and Ge samples were doped with gold to produce material of sufficiently high resistivity at the working temperature of 77°K, and were formed into small parallel-plate capacitors. The permittivity of Si is 11·7 ± 0·2 at 1 Mc/s and remains constant within ± 1% over the range 500 c/s–30 Mc/s. The corresponding value for Ge is 15·8 ± 0·2; its much greater apparent variation with frequency is ascribed to sample inhomogeneity.

537.311.33 : [546.28 + 546.289] : 532.2 **1804**

Shapes of Floating Liquid Zones between Solid Rods.—P. H. Keck, M. Green & M. L. Polk. (*J. appl. Phys.*, Dec. 1953, Vol. 24, No. 12, pp. 1479–1481.) The method described by Keck & Golay (*Phys. Rev.*, 15th March 1953, Vol. 89, No. 6, p. 1297) for crystallizing Si from a melt involves holding the molten Si between two vertically aligned solid rods of Si. The shape and stability of the molten Si are investigated theoretically.

537.311.33 : 546.28 **1805**

Gold as a Donor in Silicon.—E. A. Taft & F. H. Horn. (*Phys. Rev.*, 1st Jan. 1954, Vol. 93, No. 1, p. 64.) The experimentally determined resistivity/temperature characteristic indicates that Au produces a donor level 0·33 eV above the occupied band in Si.

537.311.33 : 546.289 **1806**

Lattice-Scattering Mobility in Germanium.—F. J. Morin. (*Phys. Rev.*, 1st Jan. 1954, Vol. 93, No. 1, pp. 62–63.) The temperature dependence of the lattice-scattering mobility of holes and electrons was determined from conductivity measurements. The variation with temperature of the ratio Hall-mobility/conductivity-mobility for holes suggests that the valence band is composed of multiple surfaces of minimum energy.

537.311.33 : 546.289 **1807**

Preparation of *p-n* Junctions by Surface Melting.—K. Lehovec & E. Belmont. (*J. appl. Phys.*, Dec. 1953, Vol. 24, No. 12, pp. 1482–1484.) A r.f.-heating method of preparing single or multiple *p-n* junctions is described. The influence of (*a*) heater temperature, (*b*) forced cooling, and (*c*) thickness of the slice of the single-crystal semiconductor on the position of the solid/liquid interface is calculated from a one-dimensional model.

537.311.33 : 546.289 : 535.215 **1808**

Infrared Photoconductivity due to Neutral Impurities in Germanium.—E. Burstein, J. W. Davisson, E. E. Bell, W. J. Turner & H. G. Lipson. (*Phys. Rev.*, 1st Jan. 1954, Vol. 93, No. 1, pp. 65–68.) Experimental determination at liquid-He temperatures of the photoconductivity in the wavelength range 1–38 μ of *n*-type and *p*-type Ge containing various donor and acceptor impurities.

537.311.33 : 546.41-31 **1809**

Calcium Oxide, an Amphoteric Semiconductor.—K. Hauffe & G. Tränckler. (*Z. Phys.*, 17th Nov. 1953, Vol. 136, No. 2, pp. 166–178.) Conductivity measurements on CaO at 600°C indicate that at oxygen pressures $>10^{-2}$ Torr CaO is a *p*-type semiconductor, at pressures $<10^{-2}$ Torr an *n*-type semiconductor. Addition of Li_2O results in *p*-type conduction even in a high vacuum, the conductivity increasing with increasing O_2 pressure and decreasing in high vacuum. Addition of Y_2O_3 gives opposite results, and is beneficial in alkaline-earth oxide cathodes.

537.311.33 : 546.47-31 **1810**

Conductivity and Hall Effect of ZnO at Low Temperatures.—S. E. Harrison. (*Phys. Rev.*, 1st Jan. 1954, Vol. 93, No. 1, pp. 52–62.) Results of measurements on single-crystal and polycrystalline specimens are used in assessing the adequacy of various energy-level models of ZnO.

537.311.33 : 546.482.21 **1811**

Demonstration of Traps in CdS Single Crystals.—W. Muscheid. (*Ann. Phys., Lpz.*, 15th Dec. 1953, Vol. 13, Nos. 6/8, pp. 322–326.) Results of an experimental investigation of the effect of illumination and rate of heating or cooling on the dark current indicate that traps are produced by incorporating oxygen in the CdS crystals.

537.311.33 : 546.482.21 : 535.215 **1812**

The Effect of Oxygen on the Conductivity of CdS Single Crystals.—W. Muscheid. (*Ann. Phys., Lpz.*, 15th Dec. 1953, Vol. 13, Nos. 6/8, pp. 305–321.) Measurements are reported of the dark conductivity and photoconductivity at various pressures of air and oxygen, in the temperature range 300°–700°K.

537.311.33 : 546.482.21 : 538.632 **1813**

Hall-Effect Measurements on CdS Crystals.—H. Diedrich. (*Ann. Phys., Lpz.*, 15th Dec. 1953, Vol. 13, Nos. 6/8, pp. 349–352.) Results of measurements in the absorption region at various illumination intensities give excess-electron mobilities of 20–400 cm/s per V/cm. The mobility depends on the conduction-electron concentration.

537.311.33 : 546.482.21.03 **1814**

Optical and Electrical Properties of Cadmium-Sulphide Single Crystals.—H. Gobrecht & A. Bartschat. (*Z. Phys.*, 17th Nov. 1953, Vol. 136, No. 2, pp. 224–233.)

537.311.33 : 546.561-31 **1815**

Electrical Conductivity of Cuprous Oxide.—A. I. Andrievski, V. I. Voloshchenko & M. T. Mischchenko. (*C. R. Acad. Sci. U.R.S.S.*, 1st June 1953, Vol. 90, No. 4, pp. 521–523. In Russian.) Results of an experimental investigation indicate that the conductivity of the Cu_2O surface layer is proportional to the number of crystalline grains per unit area and is independent of the method of production.

537.311.33 : 546.682.86 **1816**

A Note on the Semiconducting Compound InSb.—F. A. Cunnell, E. W. Saker & J. T. Edmond. (*Proc. phys. Soc.*, 1st Dec. 1953, Vol. 66, No. 408B, pp. 1115–1116.) Measurements were made on an ingot purified by zone

melting. The variations of the conductivity and of the Hall constant with distance along the ingot from the pure end, and with temperature, are shown graphically. The results are discussed briefly.

537.311.33 + 538.63] : 546.762.21 **1817**

Electrical and Galvanomagnetic Properties of Sulphides of Chromium.—N. P. Grazhdankina & I. G. Fakidov. (*C. R. Acad. Sci. U.R.S.S.*, 21st Nov. 1953, Vol. 93, No. 3, pp. 429–430. In Russian.) Classification according to resistivity places these sulphides intermediate between metals and semiconductors. Measurements were made of (*a*) the resistance at very low temperatures, (*b*) the Hall effect, and (*c*) the magnetoresistance effect. The results of (*a*) and (*c*) are shown graphically.

537.311.33 : 546.817.221 **1818**

Interpretation of Hall Effect and Resistivity Data in PbS and Similar Binary Compound Semiconductors.—W. W. Scanlon. (*Phys. Rev.*, 15th Dec. 1953, Vol. 92, No. 6, pp. 1573–1575.) Discrepancies in published data on the width of the forbidden energy gap for PbS are accounted for by the occurrence of thermal changes in composition during experimental runs. Measurements confined to temperatures below 500°K, for which such changes do not take place, give a figure of 0·37 ± 0·01 eV, in agreement with optical data.

537.311.33 : 621.314.634 **1819**

Mode of Operation of CdSe Intermediate Layers in Selenium Rectifiers.—A. Hoffmann & F. Rose. (*Z. Phys.*, 17th Nov. 1953, Vol. 136, No. 2, pp. 152–165.) An experimental investigation. Results indicate that the blocking action in commercial Se rectifiers with counter electrodes containing Cd occurs at the CdSe/Se boundary, CdSe and Se being *n*-type and *p*-type semiconductors respectively. The CdSe layer has not a sufficiently high resistivity to act as an 'isolating' hole layer with multi-point contact rectification.

537.312.8 **1820**

Effect of Composition on Change of Electrical Resistance of Ni-Mn Alloys in a Magnetic Field.—I. Ya. Dekhtyar. (*C. R. Acad. Sci. U.R.S.S.*, 1st Dec. 1953, Vol. 93, No. 4, pp. 637–639. In Russian.) The variation of the fractional change of resistance of Ni-Mn alloys with variation of the percentage of Mn in the alloy was determined experimentally at several values of the magnetic field strength. The influence of Cu or Sn impurity atoms was also investigated. The results are presented graphically.

538.213 : 621.3.042.15 **1821**

Effective Permeabilities of Regular Configurations of Spherical Ferromagnetic Particles.—I. Lucas. (*Frequenz*, Oct. 1953, Vol. 7, No. 10, pp. 289–295.) Estimation of effective permeability is based on an approximation to the magnetic-field distribution near the points of contact of the particles. For the closest packing, the effective permeability, μ_w, is related to the bulk permeability of the material, μ, by the formula $\mu_w = \sqrt{2}\,\pi \log \mu$. Agreement with measurements on sendust (Fe-Si-Al-alloy) and carbonyl-iron powder cores is satisfactory.

538.221 **1822**

An Amplitude- and Temperature-Dependent After Effect in α-Fe at −70°C.—G. Sorger. (*Z. angew. Phys.*, Nov. 1953, Vol. 5, No. 11, pp. 406–413.) An anomaly in the complex permeability observed at about −70°C in Fe and Fe-Si alloys with α-type lattice was investigated. The after-effect decreases with an increase of applied field strength. The activation energy is 0·3 eV/atom. See also 1631 of 1952 (Feldtkeller et al.).

538.221 **1823**

Developments in Sintered Magnetic Materials.—J. L. Salpeter. (*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 514–526.) Reprint. See 3334 of 1953.

538.221 : 538.561.029.6 **1824**

Ferromagnetic Resonance using Waves from a Mass Emitter.—K. A. Volkova. (*C. R. Acad. Sci. U.R.S.S.*, 1st April 1953, Vol. 89, No. 4, pp. 655–658. In Russian.) Measurements were made of the heat dissipated in Fe and in Ni specimens subjected to a steady magnetic field of 100–13 500 oersted and a superimposed h.f. field of mean frequency variable between 21·4 and 125 kMc/s. The latter field was produced by the wide-band mass emitter described by Glagoleva-Arkad'eva (2106 of 1943). The experimental results are shown graphically. Ferromagnetic dispersion is briefly discussed.

538.221 : 538.632 **1825**

Spontaneous Hall Effect in Ferromagnetics.—J. Smit & J. Volger. (*Phys. Rev.*, 15th Dec. 1953, Vol. 92, No. 6, pp. 1576–1577.) Results of measurements on several specimens of Ni and Ni alloys are tabulated and discussed.

538.221 : 621.318.1 : 621.314.22.018.75 **1826**

Pulse Permeability and Losses in Magnetic Materials subjected to Rectangular D.C. Pulses.—T. Einsele. (*Frequenz*, Oct. 1953, Vol. 7, No. 10, pp. 281–289.) Measurements of maximum pulse permeabilities and total losses under steady operating conditions are reported for cores of siferrit 2000 Tr 7, permenorm 3601 and mumetal. When simplifying assumptions are made, the maximum pulse power that can be dealt with by a transformer of specified core material, for given pulse duration and repetition rate, can be calculated.

538.221 : [621.318.124 + 621.318.134 **1827**

Ferromagnetic Ferrites.—Y. Lescroël. (*Câbles & Transm.*, Oct. 1953, Vol. 7, No. 4, pp. 273–292.) Characteristic properties of ferrites are examined with reference to three materials developed since 1950, namely (*a*) fermalite, a mixed Mn-Zn ferrite, of which three principal types are manufactured; Type 1002 for coils operating at frequencies up to 1 Mc/s; Type 2001 for wide-band transformers, and reaction coils; Type 3001 for h.f. power and pulse transformers; (*b*) fernilite, a Ni-Zn ferrite for applications at frequencies up to 100 Mc/s; (*c*) fercolite, a Co ferrite used for light-weight permanent magnets.

538.221 : [621.318.124 + 621.318.134 **1828**

Magnetic Resonance in Ferrimagnetics.—R. K. Wangsness. (*Phys. Rev.*, 1st Jan. 1954, Vol. 93, No. 1, pp. 68–71.) The general expression for the magnetic resonance frequency of the two-sublattice model of a ferrimagnetic crystal has essentially the same form as that originally obtained for the ferromagnetic case provided that the product of the molecular field coefficient and the net magnetization is large compared to the applied and anisotropy fields.

538.221 : 621.318.134 **1829**

Effect of Cross-Section Area and Compression upon the Relaxation in Permeability for Toroidal Samples of Ferrites.—R. E. Alley, Jr, & F. J. Schnettler. (*J. appl. Phys.*, Dec. 1953, Vol. 24, No. 12, pp. 1524–1525.) The real and the imaginary components of permeability of MnZn and NiZn ferrites were determined experimentally over the frequency range 25 kc/s–2 Mc/s. Only the MnZn showed a change in the relaxation frequency with change of cross-section. The two ferrites also responded differently to compression. The results are shown graphically.

538.221 : 621.318.134 **1830**

Magnetization in Nickel Ferrite-Aluminates and Nickel Ferrite-Gallates.—L. R. Maxwell & S. J. Pickart. (*Phys. Rev.*, 1st Dec. 1953, Vol. 92, No. 5, pp. 1120–1126.) Measurements were made on materials prepared by substituting trivalent Al and Ga for part or all of the trivalent Fe in $NiO.Fe_2O_3$. Graphs show the variation with composition of the unit cell size and of the saturation magnetization extrapolated to 0°K.

538.221 : 621.318.134 **1831**

Ionic Distribution deduced from the g-Factor of a Ferrimagnetic Spinel: Ti^{4+} in Fourfold Co-ordination.—E. W. Gorter. (*Nature, Lond.*, 16th Jan. 1954, Vol. 173, No. 4394, pp. 123–124.)

538.221 : 621.318.134 **1832**

Ferromagnetic Resonance of Nickel-Zinc Ferrites.—E. I. Kondorski & N. A. Smol'kov. (*C. R. Acad. Sci. U.R.S.S.*, 11th Nov. 1953, Vol. 93, No. 2, pp. 237–240. In Russian.) The relaxation times and g-factors of three ferrites were calculated from results of an experimental determination of the real and imaginary components of the magnetic permeability and the dielectric constant at wavelengths of 3·2 and 8·6 cm with the sample placed in a steady magnetic field. The experimental method is described. Results are tabulated and, for one ferrite, shown graphically.

538.222/.224 **1833**

Resonance Absorption in Metals at Centimetre Wavelengths.—S. G. Salikhov. (*C. R. Acad. Sci. U.R.S.S.*, 11th Nov. 1953, Vol. 93, No. 2, pp. 241–244.) Measurements are reported on 28 pure metals at temperatures of 90° and 290°K using a frequency of 9·378 kMc/s. The table of results gives the atomic susceptibility, paramagnetic absorption, g-factor, line width and line intensity. Some results are also shown graphically.

538.567 : 539.234 : 546.57 **1834**

The Electrical Properties of Thin Evaporated Silver Films at 3 000 Mc/s.—F. J. Tischer. (*Z. angew. Phys.*, Nov. 1953, Vol. 5, No. 11, pp. 413–415.) The films discussed are of a type used in microwave attenuators and terminating resistors. Radiation penetration depth and reflection and transmission coefficients are investigated, taking into account the effect of the mica base and the displacement current in the layer. The theoretical and experimental values of the reflection and transmission coefficients are compared and the material constants are calculated.

538.653.2 : [546.72 + 546.74 **1835**

Effect of Plastic Deformation on the Magnetization Curves of Iron and Nickel in High-Strength Magnetic Fields.—V. V. Parfenov. (*C. R. Acad. Sci. U.R.S.S.*, 21st Nov. 1953, Vol. 93, No. 3, pp. 435–438. In Russian.) Report of experimental investigation using field strengths up to 10 000 oersted.

547.476.3 **1836**

Dielectric Properties of Some Double Tartrates.—F. Jona & R. Pepinsky. (*Phys. Rev.*, 15th Dec. 1953, Vol. 92, No. 6, p. 1577.) No dielectric anomaly is found for the Na-Rb salt in the temperature range 4·2°K–333°K but a dielectric anomaly appears in the $NaNH_4$ salt at 109°K.

548.0 : 539.378.3 **1837**

Some Predicted Effects of Temperature Gradients on Diffusion in Crystals.—A. D. LeClaire; J. A. Brinkman; W. Shockley. (*Phys. Rev.*, 15th Jan. 1954, Vol. 93, No. 2, pp. 344–346.) Discussion on 1122 of April and author's reply.

549.514.51 : 539.31 **1838**

Anelasticity of Quartz.—R. K. Cook & R. G. Breckenridge. (*Phys. Rev.*, 15th Dec. 1953, Vol. 92, No. 6, pp. 1419–1423.) Measurements were based on the method of Cook & Weissler (650 of 1951). Anelasticity, i.e. internal friction, has a maximum value at a temperature between room temperature and the quartz inversion temperature of 573°C, the value being greatly increased when foreign atoms are present in the lattice. Activation energies and relaxation time constants were deduced for 4 quartz bars studied.

621.315.61 **1839**

Progress in Dielectrics.—S. Whitehead. (*Elect. Rev., Lond.*, 11th Dec. 1953, Vol. 153, No. 24, pp. 1309–1313.) A survey based on a paper presented at the British Association.

621.315.61 : 538.569.3 **1840**

Absorption of Millimeter Waves in Dielectric Solids.—W. L. Brooks, J. H. Greig, C. Pine, W. G. Zoellner & J. H. Rohrbaugh. (*J. opt. Soc. Amer.*, Dec. 1953, Vol. 43, No. 12, pp. 1191–1194.) The real and imaginary parts of the complex refractive index of polystyrene, polymethyl methacrylate and a high-melting-point paraffin were determined at wavelengths between 1·79 and 4·18 mm from measurements of the magnitudes and phase angles of the transmission coefficients, using harmonics of a 12·5 mm-λ Type-3J31 magnetron.

621.315.612.6.011.5.029.42 **1841**

The Dielectric Relaxation of Glass and the Pseudo-capacity of Metal-to-Glass Interfaces, measured at extremely Low Frequencies.—J. Volger, J. M. Stevels & C. van Amerongen. (*Philips Res. Rep.*, Dec. 1953, Vol. 8, No. 6, pp. 452–470.) The dispersion of the dielectric constant was determined experimentally over the frequency range 0·1–20 c/s, at various temperatures. From theoretical considerations, the main relaxation time is inversely proportional to the transition probability of Na^+ ions jumping between adjacent interstices. The very high frequency- and temperature-dependent electrode capacitances are discussed.

669-426.2 **1842**

The Production of Fine Wires by Electrolytic Polishing.—H. R. Haines & B. W. Mott. (*J. sci. Instrum.*, Dec. 1953, Vol. 30, No. 12, pp. 459–460.) A method suitable for reducing the diameter of brittle or easily oxidized metal wires is described; it has been used successfully for Th, U, Zr and nichrome.

MATHEMATICS

517.51/.52 **1843**

On the Summation of Infinite Series in Closed Form.—A. D. Wheelon. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, pp. 113–118.)

517.942.9 **1844**

The Meaning of the Vector Laplacian.—P. Moon & D. E. Spencer. (*J. Franklin Inst.*, Dec. 1953, Vol. 256, No. 6, pp. 551–558.) The distinction between the vector and scalar Laplace operators is discussed. A general equation is developed for the vector Laplace operator in any orthogonal curvilinear coordinate system; use of this equation enables electrodynamic problems to be formulated simply by means of the vector Helmholtz equation.

517.949.8 **1845**

On Mildly Nonlinear Partial Difference Equations of Elliptic Type.—L. Bers. (*J. Res. nat. Bur. Stand.*, Nov. 1953, Vol. 51, No. 5, pp. 229–236.) Justification is given for the use of the finite-difference method for the numerical treatment of these equations.

519.271.3 : 620.113.2 **1846**

The Efficiency of Sequential Sampling for Attributes: Part 2—Practical Applications.—H. C. Hamaker. (*Philips Res. Rep.*, Dec. 1953, Vol. 8, No. 6, pp. 427–433.) The simplified equations valid under Poisson conditions are applied to the design of a slide rule from which the operating characteristic can be read off when two fundamental parameters are known. Part 1: 2715 of 1953.

519.272.119 **1847**

Error due to Finite Integration Time-Limits in the Determination of Autocorrelation Functions.—P. Blassel. (*Ann. Télécommun.*, Dec. 1953, Vol. 8, No. 12, pp. 406–414.)

MEASUREMENTS AND TEST GEAR

529.786 **1848**

Annual Fluctuations in Quartz Clock Error and Frequency Drift.—H. J. M. Abraham. (*Nature, Lond.*, 9th Jan. 1954, Vol. 173, No. 4393, pp. 73–74.) Report of an investigation of the performance of several quartz clocks in the southern hemisphere.

538.652.08 **1849**

A Method of Measuring Magnetostriction.—A. W. Cochardt. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, pp. 91–95.) The absolute magnitude of magnetostriction is determined from torsion tests on unmagnetized and magnetized wires. The error is about 3% at stresses $> 1\,000$ p.s.i.

621.317.3 : 621-526 **1850**

Measurement of L.F. Response of Servo-Mechanism Components.—E. J. P. Long. (*Engineer, Lond.*, 4th Dec. 1953, Vol. 196, No. 5106, pp. 722–725.) A description is given of apparatus for producing a sinusoidal signal in the frequency range 0·5–20 c/s, together with suitable equipment for measuring attenuation and phase shift at these frequencies. The method consists in operating a magslip so that one complete revolution of the rotor corresponds to one cycle of the required low frequency, and using the magslip as a mechanical modulator for a h.f. carrier. The display end of the apparatus consists of a two-channel oscilloscope.

621.317.3 : 621.385.029.6 **1851**

Rapid Method of testing Magnetrons in the Nonoperating State.—J. W. Dodds. (*Le Vide*, Nov. 1953, Vol. 8, No. 48, pp. 1429–1431.) The resonance frequency and the effect of loading are determined using an arrangement in which the magnetron terminates a line fed by a frequency-modulated klystron. The signal is picked up by a standing-wave detector, and the resonance condition is indicated by the shape of the curve displayed on a c.r.o. Under-coupling and over-coupling are easily identifiable. Relevant theory is given.

621.317.311 **1852**

The Measurement of Very Small Direct Currents.—M. W. Jervis. (*Electronic Engng*, March 1954, Vol. 26, No. 313, pp. 100–105.) A review of methods used for measuring currents in the range 10^{-16}–10^{-6}A, with particular reference to thermionic and capacitor modulator electrometers. 32 references.

621.317.329 : 621.373.413 **1853**

Simple Method of Measurement of the Distribution of the Electromagnetic Field in a Resonant Cavity.—A. Septier. (*C. R. Acad. Sci., Paris*, 8th Feb. 1954, Vol. 238, No. 6, pp. 658–660.) The determination of the field is based on observed variations of resonance frequency with displacement of a suitably shaped obstacle inside the cavity. Frequency variations of 1 part in 10^5 can be detected.

621.317.335.3 : 546.171.1 **1854**

Dispersion in Ammonia in 3 cm Region.—Krishnaji & P. Swarup. (*Z. Phys.*, 8th Dec. 1953, Vol. 136, No. 3, pp. 374–378. In English.) The variation of electric susceptibility with pressure was determined experimentally using a standing-wave technique; the results are tabulated and shown graphically. The value of the susceptibility at atmospheric pressure is $5{\cdot}3 \times 10^{-3}$.

621.317.342 **1855**

Measurements of Phase Angles.—A. van Weel. (*Philips Res. Rep.*, Dec. 1953, Vol. 8, No. 6, pp. 471–475.) Discussion of an improved system based on the method described previously (3659 of 1953).

621.317.382 : 538.632 : 537.311.33 **1856**

Application of the Hall Effect in a Semiconductor to the Measurement of Power in an Electromagnetic Field.—H. M. Barlow. (*Nature, Lond.*, 2nd Jan. 1954, Vol. 173, No. 4392, pp. 41–42.)

621.317.443.029.4 /.5 **1857**

A Radio-Frequency Permeameter.—P. H. Haas. (*J. Res. nat. Bur. Stand.*, Nov. 1953, Vol. 51, No. 5, pp. 221–228.) Theory and description of a permeameter for frequencies up to 20 Mc/s. The measurement of permeability and losses is made by inserting the ferromagnetic material in the form of a toroidal core into the short-circuited secondary of a transformer, the primary of which is connected to a r.f. bridge or Q meter.

621.317.7 : 537.54 : 621.396.822.029.64 **1858**

A Microwave Wide-Band Noise-Generator in Coaxial-Line Form.—W. Friz. (*Fernmeldetech. Z.*, Dec. 1953, Vol. 6, No. 12, pp. 583–587.) A description is given of the characteristics and construction of a gas-discharge noise generator for the 6·5–20-cm wavelength range, with the discharge path inside a coaxial line. The advantages of this type over the diode type are (*a*) nearly constant internal resistance, and (*b*) constant power distribution over a wide frequency range. The upper and lower frequency limits are discussed.

621.317.733 **1859**

Resistance Bridge Sensitivity and Output Formulas.—P. M. Andress. (*Elect. Engng, N.Y.*, Dec. 1953, Vol. 72, No. 12, p. 1095.) Digest of paper to be published in *Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72.

621.317.733 : 621.314.2 **1860**

Bridges with Coupled Inductive Ratio Arms as Precision Instruments for the Comparison of Laboratory Standards of Resistance or Capacitance.—C. W. Oatley & J. G. Yates. (*Proc. Instn elect. Engrs*, Part III, March 1954, Vol. 101, No. 70, pp. 91–100.) An estimate is made of errors likely to be caused by deviation of the transformer from the ideal, in respect of imperfect coupling, winding resistance, stray capacitance and eddy currents in the core. Measurements on six transformers designed to give low errors are reported. For ratios up to 100 : 1 there is no difficulty in constructing transformers whose effective ratios are equal to their turns ratios within 1 part in 10^4; even at 1000 : 1 the error need not exceed 1 or 2 parts in 10^4.

621.317.733 : 621.372.2 : 621.315.212 **1861**

Some Steady-State Characteristics of Short Irregular Lines.—Rosen. (See 1668.)

621.317.755 **1862**

A Portable High-Speed Cathode-Ray Oscillograph.—S. Waring & B. Murphy. (*J. sci. Instrum.*, Dec. 1953, Vol. 30, No. 12, pp. 469–471.) The instrument described

uses a sealed-off c.r. tube and an asymmetrical thyratron timebase which can be operated to give either a single sweep or a repeated sweep at frequencies up to 500 c/s.

621.317.761 **1863**

A Stroboscopic Frequency Meter.—C. W. McLeish & D. H. Rumble. (*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 594–596.) The instrument described is capable of giving a direct indication to the nearest kilocycle in the range 3–30 Mc/s, and is adapted for building in with the signal source (e.g. receiver local oscillator).

621.317.784.029.64 **1864**

Automatic Milliwattmeter for Electromagnetic Radiation.—J. C. van den Bosch & F. Bruin. (*Appl. sci. Res.*, 1953, Vol. B3, Nos. 4/5, pp. 260–264.) An instrument for the 1–10-cm waveband, with two ranges giving respectively 1 and 10 mW full scale deflection, comprises a Wheatstone bridge, one arm of which is formed by a thermistor enclosed in a waveguide; the bridge is balanced by varying the current through the thermistor by means of the valve circuit described.

621.317.789 : 621.373.2.029.65/.66 **1865**

Boltzmann Interferometer.—J. L. Farrands & J. Brown. (*Wireless Engr*, April 1954, Vol. 31, No. 4, pp. 81–83.) Use of the interferometer for investigating the power spectrum of spark-type oscillators is described. The spectrum is given by the Fourier transform of the interference pattern.

621.373.029.3 : 621.376.222 **1866**

A Low-Distortion Pulse Modulator.—F. Brunner. (*Öst. Z. Telegr. Teleph. Funk Fernsehtech.*, Nov./Dec. 1953, Vol. 7, Nos. 11/12, pp. 147–149.) Description of a circuit designed for investigating transients in electro-acoustic systems. A signal tone is modulated by a square-wave voltage the frequency of which is continuously variable between 4 c/s and 100 kc/s. The modulator circuit comprises two hexodes so arranged that the modulating voltage itself is eliminated in the output.

621.373.1.029.42 : 621-526 **1867**

Forcing Function Generator using Conductive Plastic.—L. W. Norman. (*Elect. Engng, N.Y.*, Dec. 1953, Vol. 72, No. 12, p. 1112.) Digest of paper to be published in *Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72. A potentiometer made of conductive plastic is used to obtain a signal of frequency between 0·05 and 60 c/s and of controllable waveform, for testing servomechanisms.

621.397.2.001.4 **1868**

The Application of Pulse Technique in the Testing of Television Transmission Circuits.—H. Röschlau. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 9/10, pp. 187–190.) The pulse-echo meter used by the Federal German Post Office provides either direct-voltage square-wave pulses of $12{\cdot}5 \times 10^{-8}$ sec duration, or alternately positive and negative square-wave pulses of duration $4{\cdot}7 \times 10^{-8}$ sec. It can be used either for the detection of cable irregularities or, with the addition of a special filter, as mismatch indicator. The double-reflection test set operates with a sine-squared test pulse having a repetition rate equal to the television-picture line frequency.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

535.824 : 621.397.6 **1869**

Television Optics.—Zschau. (See 1932.)

621.317.083.7 **1870**

Telemetering Systems.—W. Bösch. (*Microtecnic*, 1952, Vol. 6, No. 6, pp. 303–311 & 1953, Vol. 7, Nos. 1–3 & 5, pp. 19–24, 85–91, 142–148 & 256–260.) A comprehensive review.

621.384.611 **1871**

Acceleration of Partially Stripped Heavy Ions.—R. S. Livingston. (*Nature, Lond.*, 9th Jan. 1954, Vol. 173, No. 4393, pp. 54–57.) Description of the 63-in. cyclotron at Oak Ridge (Tennessee) and of nuclear research carried out with this machine; the hot-cathode source used to produce partially stripped ions is a unique feature.

621.384.611 **1872**

Characteristics of a Proposed Double-Mode Cyclotron.—M. J. Jakobson & F. H. Schmidt. (*Phys. Rev.*, 15th Jan. 1954, Vol. 93, No. 2, pp. 303–305.) Operation of a two-dee fixed-frequency cyclotron with the dee voltages either in phase opposition or in the same phase is discussed. The system would be useful for accelerating ions heavier than α particles.

621.384.612 **1873**

The Profile of the [pole] Pieces of Strong-focusing Cosmotrons with Small Diameter.—G. Sasson. (*C. R. Acad. Sci., Paris*, 22nd Feb. 1954, Vol. 238, No. 8, pp. 885–888.)

621.384.622 **1874**

Improvement of the Performance of a Linear Accelerator by bunching the Electrons before Injection.—M. Papoular. (*C. R. Acad. Sci., Paris*, 15th Feb. 1954, Vol. 238, No. 7, pp. 789–791.) Analysis indicates that considerable increase of efficiency is attainable by this method.

621.384.622.1 **1875**

The Magnitude of the Divergence caused by the Accelerating Gaps in Linear Ion Accelerators.—M. V. Bernard. (*C. R. Acad. Sci., Paris*, 8th Feb. 1954, Vol. 238, No. 6, pp. 675–677.)

621.385.833 **1876**

A New Microscope Principle.—J. M. Cowley. (*Proc. phys. Soc.*, 1st Dec. 1953, Vol. 66, No. 408B, pp. 1096–1100.) A high-resolution image may be derived from a large number of 'dark field' images of normal resolution obtained by varying the angle of incidence of the electron beam in a standard electron microscope. The practical limitations of this theoretical result are discussed.

621.385.833 **1877**

Calculation of the Axial Potential of Electron Lenses constituted by Two Coaxial Cylinders of Different Diameters.—P. Ehinger. (*C. R. Acad. Sci., Paris*, 22nd Feb. 1954, Vol. 238, No. 8, pp. 879–881.) The axial position of the equipotential surface whose mean curvature is zero is introduced as reference parameter.

621.387.4 : 519.2 **1878**

Stochastic Theory of Electronic Counters.—F. Pollaczek. (*C. R. Acad. Sci., Paris*, 15th Feb. 1954, Vol. 238, No. 7, pp. 766–768.)

621.387.424 **1879**

The Behaviour of Counters with External Cathode and Pure Methyl-Alcohol Filling, subjected to Gamma Radiation.—D. Blanc. (*C. R. Acad. Sci., Paris*, 8th Feb. 1954, Vol. 238, No. 6, pp. 673–675.) Report of an experimental investigation to determine the value of pressure for best performance.

621.387.424 **1880**

The Delay in the Build-up of Halogen-Quenched Counters.—D. van Zoonen. (*Appl. sci. Res.*, 1953, Vol. B3, Nos. 4/5, pp. 377–389.) Continuation of the experiments of van Zoonen & Prast (1463 of 1953).

621.389 : 620.16 **1881**

Symposium on 'Vibration Methods of Testing'.—(*J. Brit. Instn Radio Engrs*, March 1954, Vol. 14, No. 3, pp. 93–126.) Text of, and discussion on, four papers, as listed below, dealing with the application of electronics to the measurement of mechanical vibrations.

Vibration Generators, Ancillary Equipment and Applications (pp. 94–100).—H. Moore.

Electronic Stroboscopes (pp. 101–105).—F. M. Savage.

Resistance Strain Gauges and Vibration Measurement (pp. 106–114).—P. Jackson.

Electronic Aids to Vibration Measurement (pp. 115–124).—R. K. Vinycomb.

621.397.9 : 612.1 **1882**

Particle Counting by Television Techniques.—L. E. Flory & W. S. Pike. (*RCA Rev.*, Dec. 1953, Vol. 14, No. 4, pp. 546–556.) Description, with circuit diagram, of a closed-circuit television system designed for counting blood cells.

621.385 **1883**

Electron Optics. [Book Review]—Klemperer. (See 1976.)

PROPAGATION OF WAVES

621.396.11 **1884**

Radio Communication by Scattering from Meteoric Ionization.—V. R. Eshleman & L. A. Manning. (*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 530–536.) The amplitude and duration of forward scattered echoes from individual meteor trails, and the probability of detecting randomly oriented trails over an oblique propagation path are examined. The results indicate that for a frequency of about 15 Mc/s the trail ionization would give a practically continuous signal over a path of about 1 000 km. For v.h.f. signals, scattering from the meteor trails is at least an important contributory factor in the propagation; further observations are required in order to evaluate this factor.

621.396.11 : 551.510.52 **1885**

The Troposphere as a Medium for the Propagation of Radio Waves: Part 2.—H. Bremmer. (*Philips tech. Rev.*, Dec. 1953, Vol. 15, No. 6, pp. 175–181.) Continuation of survey noted in 1548 of May. A discussion of scattering is presented, based on theory and observations.

621.396.11 : 551.510.535 **1886**

Real and Complex Wave Polarization in the Ionosphere.—J. C. W. Scott. (*J. geophys. Res.*, Dec. 1953, Vol. 58, No. 4, pp. 437–443.) "The relation between the polarization ellipse in the wave front and the complex polarization at vertical incidence in a slowly-varying horizontally-stratified ionosphere is reviewed. Charts and a table are given showing the sense, orientation and eccentricity of the polarization ellipse under all conditions of plasma frequency, collisional frequency, wave frequency, and magnetic field intensity and direction."

621.396.11 : 551.510.535 **1887**

On the Coupled Wave Equations of Magneto-ionic Theory.—J. M. Kelso. (*J. geophys. Res.*, Dec. 1953, Vol. 58, No. 4, pp. 431–436.) The coupled wave equations describing the propagation of a radio wave incident vertically on a horizontally stratified ionosphere [1884 of 1942 (Försterling)] and the basic defining relations are presented so as to show explicitly the confusing effects resulting from the different forms used by other authors. The various notations are tabulated.

621.396.11 : 551.510.535 **1888**

High-Frequency Scatter-Sounding Experiments at the National Bureau of Standards.—R. Silberstein. (*Science*, 25th Dec. 1953, Vol. 118, No. 3078, pp. 759–763.) Four basic types of presentation used in investigating skip distance by means of back-scattered echoes are discussed, namely (*a*) intensity/range at fixed frequency, (*b*) range/time at fixed frequency, (*c*) p.p.i., and (*d*) sweep-frequency records. Experimental results confirm that skip-distance determination by back-scatter methods is not always possible. The technique calls for skilled personnel familiar with the regular behaviour of the ionosphere in the region.

621.396.11 : 551.510.535 **1889**

Maximum Usable Frequencies and Lowest Usable Frequencies for the Path Washington to Resolute Bay.—G. H. Hanson, H. V. Serson & W. Campbell. (*J. geophys. Res.*, Dec. 1953, Vol. 58, No. 4, pp. 487–491.) WWV transmissions were monitored continuously at Resolute Bay, 4 009 km away, for a period of one year; values of the m.u.f.'s and l.u.f.'s were determined from the records. The predicted m.u.f.'s were found to be too low during the night and, for some months, too high during the day. The l.u.f.'s were lower than expected for propagation by one reflection from the F_2 layer.

621.396.11.029.55 **1890**

Measurements of Angle of Arrival in the Short-Wave Range.—K. Vogt. (*Fernmeldetech. Z.*, Nov. 1953, Vol. 6, No. 11, pp. 537–539.) The procedure and results of measurements reported since 1934 are reviewed. The need for further investigation of the dependence of angle of arrival on sunspot cycle and direction of propagation is evident.

621.396.11.029.6 **1891**

Metre, Decimetre and Centimetre Waves far beyond the Horizon.—E. Roessler. (*Frequenz*, Nov. 1953, Vol. 7, No. 11, pp. 313–319.) A review of recent literature on long-distance u.h.f. propagation, and of the consequences for the planning of radio transmissions and links.

621.396.11.029.62 **1892**

A Simple Method for estimating U.S.W. Propagation within Line of Sight.—E. Prokott. (*Telefunken Ztg*, Dec. 1953, Vol. 26, No. 102, pp. 346–352.) The distribution of illumination intensity over a relief map illuminated by a lamp placed at the top of a model of the transmitter aerial mast is in fair agreement with measured line-of-sight u.s.w. field-strength distribution. A correction factor for diffraction is given.

621.396.11.029.62 **1893**

Report of Propagation Tests on 45 and 66·6 Mc/s in the Central Mediterranean.—J. Roux. (*Ann. Radioélect.*, Oct. 1953, Vol. 8, No. 34, pp. 318–330.) During summer 1952 and early 1953 continuous records were made of field strength, signal/noise ratio, interference, and meteorological data for two over-sea transmission paths of 245 and 285 km respectively, proposed for radio relay links between Europe and North Africa. Results of an analysis of the records are presented, these include details of interfering signals, the most remarkable of which were from Berlin, from Monte Cavo, near Rome, and television transmissions from Paris.

621.396.11.029.64/.65 **1894**

Atmospheric Attenuation of Millimetre and Centimetre Waves.—A. Perlat & J. Voge. (*Ann. Télécommun.*, Dec. 1953, Vol. 8, No. 12, pp. 395–405.) Tables and curves

showing the attenuation per kilometre in the 10-mm–10-cm frequency range due to various forms of precipitation, fogs and cloud are assembled from the literature. Meteorological statistics for France and North Africa are also presented. From these, the maximum attenuation to be expected over a given path during a particular percentage of time can be estimated for each meteorological factor.

RECEPTION

621.376.33 **1895**

High-Linearity Demodulation of Frequency-Modulated Oscillations.—H. Meinke. (*Fernmeldetech. Z.*, Dec. 1953, Vol. 6, No. 12, pp. 571–577.) The conditions are derived for high linearity of a demodulator consisting of four reactances, one effective resistance and one rectifier. The characteristics of several possible circuits are considered briefly; one circuit is considered in detail.

621.396.621 **1896**

Analysis of a Limiter as a Variable-Gain Device.—L. R. Kahn. (*Elect. Engng, N.Y.*, Dec. 1953, Vol. 72, No. 12, pp. 1106—1109.) The limiter is treated as a device whose gain is varied so that the amplitude-modulation component of the input signal is eliminated. The method is demonstrated by considering the sideband spectrum of the phase-modulation component of a two-tone signal and the mechanism of the common-limiter diversity system.

621.396.621 **1897**

Post-War Development of Broadcast Receivers [in Western Germany].—E. Klotz & G. Schaffstein. (*Telefunken Ztg*, Dec. 1953, Vol. 26, No. 102, pp. 372–382.) A survey with particular reference to the development of v.h.f. f.m. receivers.

621.396.621.54 : 621.314.7 **1898**

The Transistor as a Mixer.—J. Zawels. (*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 542–548.) Operation is considered for signal frequencies up to v.h.f., three frequency ranges being distinguished, namely (*a*) the lowest range, in which the conversion performance depends primarily on the α value of the transistor; (*b*) a middle range in which the base resistance is the dominant factor; (*c*) the high-frequency range where the capacitance shunting the reverse-biased emitter determines the perf•rmance. Methods for calculating the conversion gain are indicated, and some measurements are reported. At the low frequencies a junction transistor can give as good a performance as a crystal-diode mixer followed by a junction transistor amplifier. Point-contact types can give conversion gain in the v.h.f. band, but their noise factor is relatively high.

621.396.82 : 621.376.3 **1899**

Reception of an F.M. Signal in the Presence of a Stronger Signal in the same Frequency Band, and other Associated Results.—R. M. Wilmotte. (*Proc. Instn elect. Engrs*, Part III, March 1954, Vol. 101, No. 70, pp. 69–75.) Analysis based on the amplitude variation of the vector resultant of two f.m. signals of different frequencies is used to derive methods for (*a*) receiving a weak signal in the presence of a stronger one, (*b*) reducing the interfering effect of a weak signal on a stronger one, and (*c*) transmitting a number of weak coded messages with an f.m. signal and in the same band. The bandwidths required by various f.m. multiplex systems are compared.

621.396.822 **1900**

On the Detection of Sure Signals in Noise.—R. C. Davis. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, pp. 76–82.) Several criteria for an optimum pre-detection filter are compared. When the input noise is Gaussian, the optimum filter is identical with the linear filter which maximizes the output signal/noise ratio. The stability of the optimum filter is discussed in some detail, the discussion applying in the practical case only to finite-memory filters. The determination of an optimum signal shape of given energy content and duration is considered.

621.396.828 **1901**

Review of the Pilot Radio-Interference-Suppression Campaign in Iserlohn.—O. Schmidt. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 9/10, pp. 191–193.) Details of the organization, measurements and equipment required in dealing with some 600 industrial and domestic sources of interference are given. Difficulties in design and supply at reasonable cost of efficient mains filter units were encountered.

621.396.621(083.72) **1902**

British Standard Glossary of Terms for the Electrical Characteristics of Radio Receivers (B.S. 2065 : 1954). [Book Review]—Publishers: British Standards Institution, London, 1954, 6s. (*Wireless World*, April 1954, Vol. 60, No. 4, p. 188.)

STATIONS AND COMMUNICATION SYSTEMS

621.376.3 : 517.942.922 **1903**

The Representation of a Frequency-Modulated Oscillation by means of Bessel Functions.—V. Poledna. (*Frequenz*, Nov. 1953, Vol. 7, No. 11, pp. 336–338.)

621.376.3 : 621.396.82 **1904**

Reception of an F.M. Signal in the Presence of a Stronger Signal in the same Frequency Band, and other Associated Results.—Wilmotte. (See 1899.)

621.376.5 **1905**

Gaussian Pulses.—J. P. Vasseur. (*Ann. Radioélect.*, Oct. 1953, Vol. 8, No. 34, pp. 286–300.) The advantage of using Gaussian-shaped pulses in p.m. systems is noted. Pulses of this shape may be derived from a narrow pulse by means of a *RC* filter chain. A band-pass filter of this type is described. The a.m. and f.m. distortion which may occur in transmitting these pulses is calculated.

621.39.001.11 **1906**

Bandwidth, Holding Time and Signal/Noise Ratio for Various Forms of Communication in Relation to Shannon's Theory.—K. O. Schmidt. (*Fernmeldetech. Z.*, Dec. 1953, Vol. 6, No. 12, pp. 555–563 & Jan. 1954, Vol. 7, No. 1, pp. 33–43.)

621.39.001.11 **1907**

The Application of Information Theory to Data-Transmission Systems, and the Possible Use of Binary Coding to increase Channel Capacity.—J. F. Coales. (*Proc. Instn elect. Engrs*, Part III, March 1954, Vol. 101, No. 70, p. 76). Discussion on 253 of January.

621.39.001.11 **1908**

Exact Interpolation of Band-Limited Functions.—A. Kohlenberg. (*J. appl. Phys.*, Dec. 1953, Vol. 24, No. 12, pp. 1432–1436.) A general formula is derived for the spectrum of a multiply periodic, a.m. sequence of pulses. The result is used to show that a function which lies in a frequency band (W_o, $W_o + W$) is completely determined by its values at a set of points of density $2W$, the points consisting of two similar groups with spacing $1/W$ shifted with respect to each other. This verifies a supposition commonly accepted in communication theory.

621.395.724 : 621.395.44 **1909**

Standardized Equipment Type 51L.—J. Malézieux, R. Sueur & M. Lebedinsky. (*Câbles & Transm.*, Oct. 1953, Vol. 7, No. 4, pp. 313–324.) Description of new French Post Office equipment standardized on the rack principle, particularly for carrier-current repeater stations.

621.396 : 621.372.5 **1910**

Radio-Frequency Phase-Difference Networks: a New Approach to Polyphase Selectivity.—M. G. Cifuentes & O. G. Villard, Jr. (*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 588–593.) The possibilities of polyphase methods [313 of 1951 (Macdiarmid & Tucker)] for obtaining selectivity are extended by using r.f. instead of a.f. phase-difference networks. The design of these networks is discussed. A polyphase selective system suitable for s.s.b. transmission or reception is described.

621.396.1 **1911**

Theoretical Investigation of the Appropriate Spatial Distribution of Frequency Channels for Uniform Coverage of Large Plane Areas.—P. Thiessen. (*Frequenz*, Nov. 1953, Vol. 7, No. 11, pp. 319–325.) Simplifying assumptions are made, so that the location of transmitting stations, when the number of available frequency channels is limited, can be considered solely from a geometrical point of view. Two types of grid-net are considered, rectangular and triangular, and geometrical patterns are reviewed for which adjacent-channel and co-channel interference shall be a minimum. Under ideal conditions the least number of channels required is 9, and the desirable number for adequate coverage without interference is 12 or 13.

621.396.5 : 621.318.57 **1912**

A Differential-Feedback Suppressor with Independent Two-Way Threshold-Level Adjustment.—F. Rumpel. (*Fernmeldetech. Z.*, Nov. 1953, Vol. 6, No. 11, pp. 540–543.) A description of the voice-operated switching system used at Frankfurt for the transatlantic radiotelephone service. A comparator circuit controls the switching operation during pauses and break-in working. Sensitivity in each direction can be adjusted independently to prevent interruptions due to noise at the receiving end.

621.396.61/.62 : 621.373.421.13 **1913**

A Frequency-Generating System for V.H.F. Communication Equipment.—G. J. Camfield. (*Proc. Instn elect. Engrs*, Part III, March 1954, Vol. 101, No. 70, pp. 85–90.) Technique developed in connection with mobile communication systems is described. 2 000 channel frequencies are provided, using only 32 crystals, comprising three groups of ten plus one group of two. Selection is accomplished by positioning four switches, the operation thereafter being automatic. Compared with the use of a separate crystal to control each frequency, the system offers the advantages of flexibility, quartz economy, simpler maintenance, and the possibility of spacing the channels more closely.

621.396.65 : 621.396.93 **1914**

Some Aspects of the Design of V.H.F. Mobile Radio Systems.—E. P. Fairbairn. (*Proc. Instn elect. Engrs*, Part III, March 1954, Vol. 101, No. 70, pp. 53–64. Discussion, pp. 64–68.) Present practice in mobile radio systems is outlined. Methods of operation of complete simplex, two-frequency simplex ('dusimplex') and duplex systems are described. The merits of a.m. and f.m. are compared, and the possibility of making better use of available frequency bands is discussed. Valve problems are mentioned briefly.

621.396.66 : 621.372.56 **1915**

A Programme Fading Circuit.—R. C. Whitehead. (*B.B.C. Quart.*, Winter 1953/1954, Vol. 8, No. 4, pp. 252–256.) Attenuators comprising temperature-sensitive resistors are used; the resistance values are controlled by variation of a locally generated supply. Methods of segregating the control current from the signal current are considered; frequency filtering is recommended for this purpose.

621.396.66 : 621.396.712 **1916**

Monitoring and Two-Channel Operation of the RIAS Berlin Medium-Wave Transmitter.—O. v. Broecker. (*Telefunken Ztg*, Dec. 1953, Vol. 26, No. 102, pp. 342–345.) The common control equipment for the 100-kW and 200-kW transmitters is described. The operation of these transmitters either in parallel (see 1943 below) on 989 kc/s, or separately on 683 kc/s and 989 kc/s respectively, is also described.

621.396.7 : 621.396.65.029.55 **1917**

The Tangier Radio Relay System.—C. G. Dietsch. (*RCA Rev.*, Dec. 1953, Vol. 14, No. 4, pp. 557–568; *Trans. Inst. Radio Engrs*, Jan. 1954, Vol. CS-2, No. 1, pp. 65–68.) An illustrated descriptive account. The station relays telegraph, telephone and radiophoto transmissions between New York and several African, Asian and European stations. Factors considered in the choice of the geographical location are discussed. Double- and triple-diversity receivers and 1–15-kW transmitters with rhombic aerials are used, with operating frequencies in the 4–22-Mc/s range.

621.396.71.029.51 **1918**

Radio Equipment of the Long-Wave Telegraphy Station at Mainflingen near Aschaffenburg.—E. Meinel. (*Fernmeldetech. Z.*, Nov. 1953, Vol. 6, No. 11, pp. 528–537.) Illustrated descriptions are given of two 60-kW and four 50-kW transmitters operating on frequencies between 46 and 125 kc/s in the European telegraphic service. Specifications are given for the 100–200-m aerial masts which carry four T aerials and two triangular fan-type aerials, the latter equipped for diplex operation.

621.396.932 + 621.396.969.3 **1919**

Radio in the Service of the Seaman.—C. V. Robinson. (*Proc. Instn elect. Engrs*, Part I, Jan. 1954, Vol. 101, No. 127, pp. 27–28.) Chairman's address, I.E.E. Southern Centre. Communications and navigational aids are reviewed.

621.396.97 + 621.397.5 **1920**

Inaugural Address [of I.E.E. President].—H. Bishop. (*Proc. Instn elect. Engrs*, Part I, Jan. 1954, Vol. 101, No. 127, pp. 1–10.) A review of the development of broadcasting and television, with special reference to the services of the B.B.C., and to the need for international co-operation. See also *Nature, Lond.*, 6th Feb. 1954, Vol. 173, No. 4397, pp. 248–249.

SUBSIDIARY APPARATUS

621-526 **1921**

Step- to Frequency-Response Transforms for Linear Servo Systems.—L. C. Ludbrook. (*Electronic Engng*, Jan.–March 1954, Vol. 26, Nos. 311–313, pp. 27–30, 51–55 & 122–126.) Five known methods for finding frequency response from a given graph of linear mode step response are discussed. Theory and practical computing routines are given for a new method based on straight-line-segment approximation to the given step-response graph. Approximate laws relating cut-off frequency and frequency and amplitude of maximum response to the

shape and time scale of the step response are derived. Discrepancies between experimental results and those derived from the theory are ascribed mainly to non-linearity of practical systems.

621.3.013.783 **1922**

Electromagnetic Shielding with Transparent Coated Glass.—E. I. Hawthorne. (*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 548–553.) The shielding effectiveness of multilayer coated plane glass structures is investigated by determining their transmission factor for plane e.m. waves. Three types of glass are considered, at frequencies up to 10 kMc/s. Transmission-line theory is used in the analysis, the coatings being represented by shunting resistances. Theoretical and experimental results are compared. Attenuations of 40 db and more can be obtained with tolerable loss of transparency.

621.311.6 : 537.311.33 : 539.165 **1923**

The Electron-Voltaic Effect in *p-n* Junctions induced by Beta-Particle Bombardment.—Rappaport. (See 1799.)

621.311.6 : 621.317.3 **1924**

Supply for Precision Measurement.—(*Elect. J.*, 11th Dec. 1953, Vol. 151, No. 24, pp. 1927–1929.) A low-impedance generator giving a highly stable comprehensive supply over the frequency range 40–2 500 c/s is based on a Wien-bridge oscillator with stabilized d.c. supplies.

621.316.722.1 **1925**

Voltage Stabilizers for Microwave Oscillators.—F. A. Benson & G. V. G. Lusher. (*Electronic Engng*, March 1954, Vol. 26, No. 313, pp. 106–110.) Analysis indicates that the effect of variation of valve heater voltage in commonly used stabilizers [3555 of 1949 (Benson)] is not serious in the case of series-parallel arrangements but may be serious where a single series valve is used.

TELEVISION AND PHOTOTELEGRAPHY

621.397.2.001.4 **1926**

The Application of Pulse Technique in the Testing of Television Transmission Circuits.—Röschlau. (See 1868.)

621.397.311.2 : 621.372.55 **1927**

Aperture Compensation for Television Cameras.—R. C. Dennison. (*RCA Rev.*, Dec. 1953, Vol. 14, No. 4, pp. 569–585.) Aperture distortion, caused by the finite size of the scanning aperture, can be compensated by using a dispersionless transversal filter [55 of 1941 (Kallmann)] designed to provide a given frequency and phase characteristic. Design equations for fixed- and variable-boost aperture compensators are developed.

621.397.5 : 621.396.1 **1928**

Television Coverage.—J. A. Saxton. (*Wireless World*, April 1954, Vol. 60, No. 4, pp. 173–176.) The influence of the terrain on the service areas of v.h.f. and u.h.f. transmitters is examined. Analysis of field-strength measurements for an area such as that around London indicates that the median field strength varies with distance according to a law of the same form as that for a smooth spherical earth, but the absolute measured values fall progressively below the theoretical values as the frequency increases. The significance of these results for television transmission in bands I, III, IV and V is discussed.

621.397.5 + 621.396.97 **1929**

Inaugural Address [of I.E.E. President].—Bishop. (See 1920.)

621.397.5 : 771.53 **1930**

Special Films for Recording Television Transmissions.—W. Behrendt. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 11/12, pp. 235–237.) Details are given of an orthochromatic film whose gradation can be varied over a wide range in processing.

621.397.5 : 778.5 **1931**

Some Fundamental Aspects of Telerecording.—C. B. B. Wood. (*J. Telev. Soc.*, Oct./Dec. 1953, Vol. 7, No. 4, pp. 143–151.) The advantages and disadvantages of waveform and picture recording are examined, and practical systems of the latter class are discussed.

621.397.6 : 535.824 **1932**

Television Optics.—H. Zschau. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 11/12, pp. 217–223.) A survey of the applications of optics in television and of television in optics. 40 references.

621.397.61 : 621.372.553 **1933**

Design of Phase Equalizers for Television-Transmission Systems.—E. Menzer & H. Voelkel. (*Fernmeldetech. Z.*, Dec. 1953, Vol. 6, No. 12, pp. 578–582.) The characteristics of an asymmetrical bridged-T section are given; application to the correction of a given phase distortion is discussed. A calculation is made for a phase equalizer for a 5-Mc/s low-pass filter, and the theoretical performance is compared with experimentally determined phase/frequency characteristics. A variable phase equalizer is briefly described.

621.397.611 : 778.5 **1934**

Scanning Film Negatives for Television.—E. Legler. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 11/12, pp. 232–234.) Gamma correction and the production of correct black-level values are discussed and a suitable circuit is illustrated. The interference ratio obtained with negatives is smaller than with positives.

621.397.611.2 **1935**

Television Pick-up Tube for both Light and X-ray Pictures.—L. Heijne, P. Schagen & H. Bruining. (*Nature, Lond.*, 30th Jan. 1954, Vol. 173, No. 4396, p. 220.) Brief note of a camera tube using a photoconductive layer of lead oxide evaporated on to a pyrex window.

621.397.611.2 : 621.397.82 **1936**

Interference Ratio and Types of Interference in Picture Scanners used in Germany at Present.—W. Dillenburger. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 11/12, pp. 209–216.) A discussion of the effects on picture quality of shot noise, mains hum, microphony and the granular structure of the mosaic target or fluorescent screen. The supericonoscope, superorthicon and a flying-spot scanner are considered.

621.397.62 **1937**

The Importance of the D.C. Component.—D. C. Birkinshaw. (*J. Telev. Soc.*, Oct./Dec. 1953, Vol. 7, No. 4, pp. 176–177.) Discussion on 552 of February.

621.397.62 **1938**

Two-Band Television Receivers.—G. H. Russell. (*Wireless World*, April 1954, Vol. 60, No. 4, pp. 189–192.) The choice of a suitable i.f. for British receivers covering bands I and III is discussed. The best frequency appears to be 35·25 Mc/s.

621.397.62 : 621.396.662 **1939**

12-Channel Television Tuner.—(*Wireless World*, April 1954, Vol. 60, No. 4, pp. 162–164.) The tuner covers the

v.h.f. bands I and III, with five switch positions for band I and seven for band III. It comprises a cascode signal-frequency amplifier and a frequency changer, and provides an output at i.f. A simplified circuit diagram is shown.

621.397.62 : 621.396.662.029.63 **1940**

A Capacitive-Tuned Ultra-High-Frequency Television Tuner.—E. M. Hinsdale, Jr. & I. D. Baumel. (*RCA Rev.*, Dec. 1953, Vol. 14, No. 4, pp. 461–481.) A tuned circuit is described consisting of a split-stator capacitor and the metal box enclosing it. Two of these circuits are used in the preselector and one in the oscillator of a 470–890-Mc/s tuner. The construction, circuit details and performance figures are given.

621.397.621.2 : 621.397.335 **1941**

Flywheel Scanning and Synchronizing Circuits.—H. Fairhurst. (*J. Telev. Soc.*, Oct./Dec. 1953, Vol. 7, No. 4, pp. 152–159.) Various systems used for flywheel synchronization are examined. Methods for eliminating effects due to variations of temperature and of mains frequency are discussed.

TRANSMISSION

621.376.32 **1942**

Investigation of a Reactance-Valve Circuit for the Frequency Modulation of Oscillators.—H. Behling. (*Telefunken Ztg*, Dec. 1953, Vol. 26, No. 102, pp. 367–370.) The circuit given is sufficiently linear and stable for use in the u.s.w. band. The modulation characteristic is derived for an arrangement using two Type EF802 valves. A comparison is made between calculated and experimentally determined characteristics for an operating frequency of about 7·5 Mc/s.

621.396.61 : 621.396.712 **1943**

Parallel Connection of Two Independent High-Power Sections in the RIAS Berlin 300-kW Medium-Wave Broadcasting Transmitter.—K. Müller. (*Telefunken Ztg*, Dec. 1953, Vol. 26, No. 102, pp. 335–341.) The bridge-type network used in coupling the output of the 100-kW and 200-kW transmitters to the common aerial is described and design considerations are discussed. Zero phase difference between the two transmitters is obtained by inserting a phase-shifting network in the line between the master oscillator and the 100-kW transmitter.

621.396.61 : 621.396.8 **1944**

Subjective and Objective Testing of the Transmission Quality of Medium-Wave Transmitters.—K. H. Baer & H. Lauer. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1953, Vol. 5, Nos. 9/10, pp. 178–186.) Details of subjective tests of music transmission on four medium-power transmitters are given and the results compared with objective distortion measurements. Three transmitters gave very satisfactory performance. Making allowance for distortion in the programme circuits, distortion in the transmitter should be less than 1% between 120 and 1 000 c/s to give good musical quality but may be slightly higher outside this range.

VALVES AND THERMIONICS

537.533 : 621.385.029.6 **1945**

Space Charge Waves in Inhomogeneous Electron Beams.—G. Kent. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, pp. 32–41.) A sheet beam confined between two plane electrodes by a large applied magnetic field provides the simplified model required for analysis. It is assumed that space charge is not neutralized, hence the beam is inhomogeneous in velocity and charge density. For small inhomogeneity and continuous variation of all quantities as functions of the inhomogeneity, growing waves are not possible. The divergence between this conclusion and those of Haeff (1825 of 1949) is discussed.

537.533.8 **1946**

The Angular Distribution of the Secondary Electrons of Soot.—J. L. H. Jonker. (*Philips Res. Rep.*, Dec. 1953, Vol. 8, No. 6, pp. 434–440.) Experimental determination using equipment previously described (1769 of 1952). The results for soot and nickel are compared.

621.314.63 + 621.314.7 **1947**

Physical Mechanism of [crystal] **Rectifiers and Transistors.**—E. Spenke. (*Z. angew. Phys.*, Dec. 1953, Vol. 5, No. 12, pp. 472–480.) A survey of known types, based on electronic-semiconductor theory.

621.314.632 : 546.289 : 537.312.6 **1948**

Thermal Effects in Point-Contact Rectifiers.—H. L. Armstrong. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, p. 136.) Correction to paper abstracted in 1242 of April.

621.314.7 **1949**

Irradiation of Transistors.—C. D. Florida, F. R. Holt & J. H. Stephen. (*Nature, Lond.*, 27th Feb. 1954, Vol. 173, No. 4400, pp. 397–398.) Measurements have been made on point-contact transistors with collector current limited by an external resistance. When the transistor was given a dose of about 10^{14} neutrons/cm², the decay of collector current after cessation of emitter current was speeded up, with little or no deterioration of the other parameters. The improvement appears to be permanent, and is attributed to the production of recombination centres such as lattice defects in the bulk material.

621.314.7 **1950**

Joining Solutions at the Pinch-Off Point in "Field-Effect" Transistor.—R. C. Prim & W. Shockley. (*Trans. Inst. Radio Engrs*, Dec. 1953, No. PGED-4, pp. 1–14.) In a field-effect transistor with the drain connection biased beyond 'pinch-off' in respect to the gate, the potential distribution is difficult to determine by analytic methods. An approximate solution is obtained which is valid over the whole length of the channel, and which completes one aspect of theory developed in 879 of 1953 (Shockley).

621.314.7 **1951**

Water Vapor and the "Channel" Effect in *n-p-n* Junction Transistors.—R. H. Kingston. (*Phys. Rev.*, 15th Jan. 1954, Vol. 93, No. 2, pp. 346–347.) Experiments are reported which indicate that the conductance of the channels described by Brown (166 of January) depends on the water-vapour pressure. The mechanism of the effect is discussed.

621.314.7 **1952**

Behavior of Germanium-Junction Transistors at Elevated Temperatures and Power-Transistor Design.—L. D. Armstrong & D. A. Jenny. (*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 527–530.) Limitations on the operation of transistors at high temperatures, resulting from the increased thermal production of hole-electron pairs, are discussed in relation to *n-p-n* and *p-n-p* types for a dissipation of about 1 W. Methods of cooling are described [see also 1247 of April (Giacoletto)] whereby satisfactory α values are maintained at collector currents >100 mA.

621.314.7 **1953**

Calculation of the Surface Recombination Current in the Junction Transistor prepared by Fusion.—J. Laplume. (*C. R. Acad. Sci., Paris*, 8th March 1954, Vol. 238, No. 10, pp. 1107–1109.) The geometry of this type of transistor is such that volume recombination is negligible in

comparison with recombination at the junction surfaces. An expression for the recombination current is derived on the assumption of a Laplacian concentration of injected charge carriers in the base.

621.314.7 **1954**

Evaluation of the Current Gain in the Fused-Junction Transistor.—J. Laplume. (*C. R. Acad. Sci., Paris*, 22nd March 1954, Vol. 238, No. 12, pp. 1300–1301.) The current gain α depends on the recombination current, a formula for which was derived previously (1953 above), and on the emitter current I_e. An approximate expression is derived for I_e based on the geometry of the junctions and on certain assumptions regarding the distribution of concentration of charge carriers. It is concluded that (*a*) α increases with collector radius, (*b*) for constant collector radius α exhibits a maximum when the emitter is slightly smaller than the collector, (*c*) when the emitter is larger than the collector α decreases rapidly. An optimum value of α is derived.

621.314.7 : 546.289 **1955**

A P-N-P Triode Alloy Junction Transistor for Radio-Frequency Amplification.—C. W. Mueller & J. I. Pankove. (*RCA Rev.*, Dec. 1953, Vol. 14, No. 4, pp. 586–598; *Proc. Inst. Radio Engrs*, Feb. 1954, Vol. 42, No. 2, pp. 386–391.) A transistor having low resistance and low capacitance is obtained by using a thick wafer of low-resistivity Ge and reducing this thickness, by drilling, to about 0·0005 in. at the region where the junctions are formed. A gain of up to 39 db at 455 kc/s can be obtained using a neutralized circuit, and up to 12 db at 10 Mc/s without neutralization. Characteristics are compared with those of the Type TA-153 transistor described by Law et al. (876 of 1953).

621.383 **1956**

Development of Photoemissive Receivers for the Far Ultraviolet Region. Photocells and Electron Multipliers.—V. Schwetzoff. (*Rev. gén. Élect.*, Feb. 1954, Vol. 63, No. 2, pp. 71–96.) A detailed study of methods of preparation of photocathodes and report of results for photocells and electron multipliers for operation at wavelengths below 2 000 Å. Prolonged heat treatment produced cathodes with very good characteristics. Ag-O-Cs and Sb-Cs photocathodes and Cu-Be electrodes for electron multipliers were specially studied. 199 references.

621.383.27 : 621.311.6 **1957**

Constancy of Photomultiplier Gain.—R. Wilson. (*J. sci. Instrum.*, Dec. 1953, Vol. 30, No. 12, pp. 472–474.) An examination is made of features of the supply circuit which affect the gain of the photomultiplier, both focused and unfocused types being considered. Supply-circuit modifications are suggested by which the gain can be stabilized.

621.383.27 : 621.396.822 **1958**

Origin of Large-Amplitude Pulses in Photomultiplier Background Noise.—Y. Koechlin, I. Pelchowitch & A. Rogozinski. (*C. R. Acad. Sci., Paris*, 8th Feb. 1954, Vol. 238, No. 6, pp. 660–662.) Measurements on an E.M.I. Type-6260 photomultiplier at low temperature indicate that large-amplitude background pulses are to a great extent attributable to scintillations of the glass, caused by various radiations.

621.383.5 **1959**

Modification of the Spectral Response Curve of a Photocell due to Illumination Fatigue.—G. Blet. (*C. R. Acad. Sci., Paris*, 1st Feb. 1954, Vol. 238, No. 5, pp. 578–579.) Measurements made before and after a fatiguing illumination (1251 of April) indicate that the response is diminished throughout the spectrum without any particular manifestation in the neighbourhood of the illumination wavelength, and that the degree of fatigue is independent of this wavelength; the effect is most marked at the long-wave end of the spectrum.

621.385.029.63/.64 **1960**

Some Remarks on Thermal Effect in an Electron Beam on the Gain of Traveling-Wave Tubes.—K. Udagawa & M. Sumi. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, pp. 135–136.) Comment on 2580 of 1951 (Parzen & Goldstein).

621.385.029.63/.64 **1961**

A Wideband Power Mixer Tube.—H. R. Johnson. (*Trans. Inst. Radio Engrs*, Dec. 1953, No. PGED-4, pp. 15–27.) The mixer valve consists of a short input helix, a drift tube and an output helix arranged successively along an electron beam and surrounded by a magnetic field. The input helix and drift tube are maintained at low potential with respect to the cathode, the output helix is operated at higher potential. The valve thus combines low modulating-voltage requirements with high power output over a wide frequency band. Expressions are developed for carrier input power, sideband output power and modulating power. Results for experimental valves operating at about 3 kMc/s and having Pierce-type guns with L cathodes are reported.

621.385.029.63/.64 **1962**

High Power Traveling-Wave Tube Gain and Saturation Characteristics as a Function of Attenuator Configuration and Resistivity.—J. J. Caldwell, Jr. (*Trans. Inst. Radio Engrs*, Dec. 1953, No. PGED-4, pp. 28–32.) Preliminary results of tests on three valves with different distributed attenuator configurations show that knowledge of loss alone is insufficient to determine attenuator performance and that the effect of loss on circuit impedance and phase velocity must also be known. For a given configuration, the attenuator with the higher resistivity gave the better performance.

621.385.029.63/.64 : 621.372.221 **1963**

Filter-Helix Traveling-Wave Tube: Part 1 — The Filter Helix, a New Circuit Element for Traveling-Wave Amplifiers and Oscillators.—W. J. Dodds & R. W. Peter. (*RCA Rev.*, Dec. 1953, Vol. 14, No. 4, pp. 502–532.) A filter helix consists essentially of a helical transmission line with periodic inhomogeneities which cause reflections. It is basically a special type of a one-dimensional lattice. Various possible constructions are discussed, and three types are distinguished. See also 1524 of 1953 (Dodds et al.).

621.385.029.64/.65 **1964**

Wave Propagation along a Magnetically-Focused Cylindrical Electron Beam.—W. W. Rigrod & J. A. Lewis. (*Bell Syst. tech. J.*, March 1954, Vol. 33, No. 2, pp. 399–416.) Theory given by Fletcher (1811 of 1950) for a beam in which the electrons move in straight lines (corresponding to infinitely strong magnetic field) is extended to the case where the electrons follow spiral paths (Brillouin flow, corresponding to finite magnetic field). The field equation is solved for the cases where the beam is surrounded (*a*) by a helix, and (*b*) by a drift tube. The gain constant for the cylindrical beam with Brillouin flow is greater than that of a similar beam with rectilinear flow but less than that of a thin hollow cylindrical beam with rectilinear flow, for the same radius, current and voltage.

621.385.029.64/.65 : 513.647.1 : 621.317.336 **1965**

Note on Helix Impedance Measurements using an Electron Beam.—D. A. Watkins & A. E. Siegman. (*J. appl. Phys.*, Jan. 1954, Vol. 25, No. 1, p. 133.) Addendum to 3753 of 1953.

621.385.032.216 **1966**

A Hollow Beam Cathode.—G. E. Mueller. (*Trans. Inst. Radio Engrs*, Dec. 1953, No. PGED-4, pp. 33–36.) Tests on hollow cathodes of various volumes and apertures show that hollow electron beams with current densities of 25 A/cm² can be produced at a temperature of 1 100°C. The emission comes from the coating on the aperture edge, the large values of current being due to continual replenishment of the active Ba at this edge from the reservoir within the cavity. Cathode current is nearly proportional to anode potential. This departure from the 3/2 power law can be explained on the basis of the cathode geometry.

621.385.032.216 **1967**

A Study of the Evaporation Products of Alkaline-Earth Oxides.—I. Pelchowitch. (*Philips Res. Rep.*, Feb. 1954, Vol. 9, No. 1, pp. 42–79.) Report of a comprehensive investigation of the evaporation characteristics of oxide-cathode materials; a mass-spectrometer method was used. BaO evaporates mainly in the form of the oxide when coated on Pt or Ni or coated in admixture with SrO and CaO on Pt. At high temperatures the BaO/Pt system gives off Ba_2O_2 ions. With the SrO/Pt and CaO/Pt systems the main evaporation product is the free element, accompanied by the oxide and the singly ionized metal ions. In the BaO/Ta system the main product is free Ba, accompanied by the oxide and by singly ionized Ba ions. The evaporation-rate/temperature curves exhibited critical points, whose existence was confirmed by resistance measurements on the oxides. The influence of the different base metals was demonstrated.

621.385.032.216 **1968**

The Properties of Oxide Cathodes regarded as Mixed Semiconductors.—J. Ortusi. (*Ann. Radioélect.*, Jan. 1954, Vol. 9, No. 35, pp. 3–36.) After activation, the BaO layer is a mixed semiconductor, i.e. with both ionic and electronic conduction. The ionic conduction, which is due to the mobility of the oxygen ion, reacts on the electronic conduction, and modifies the emission characteristics. The electronic conduction is of *n* type, based on two groups of donors, the first consisting of Ba atoms, the second of F centres.

621.385.032.216 : [546.42-31 + 546.431-31 **1969**

The Thermionic Emission from Thin Films of Barium and Strontium Oxide.—J. Woods & D. A. Wright. (*Brit. J. appl. Phys.*, Feb. 1954, Vol. 5, No. 2, pp. 74–76.) An experimental investigation is reported. The four principal results are: (*a*) emission from an evaporated film of BaO is a maximum at a layer thickness of 10^{-5} cm and, for an activated film, is approximately equal to that from a sprayed BaO cathode; (*b*) SrO behaves in a similar way, with a lower level of emission; (*c*) emission from BaO sprayed on SrO is similar to that from BaO alone; (*d*) SrO evaporated on BaO gives greater emission than either BaO or SrO alone, the d.c. emission for a SrO layer of thickness 10^{-5} cm being 9 mA/cm² at 550°C.

621.385.1 **1970**

Valve Noise produced by Electrode Movement.—P. A. Handley & P. Welch. (*Proc. Inst. Radio Engrs*, March 1954, Vol. 42, No. 3, pp. 565–573.) The effects of faulty electrode positioning and resonant vibrations of electrodes are distinguished. Expressions are derived for the resonance frequencies of the electrodes in terms of the constructional details; use of the results to improve valve design is discussed. Methods of measuring valve noise are indicated.

621.385.2/.3 **1971**

Self-Heating Thermionic Tubes.—E. G. Hopkins. (*Proc. Instn elect. Engrs*, Part III, March 1954, Vol. 101, No. 70, pp. 77–83.) Three experimental types of valve with mutually bombarding oxide cathodes (3209 of 1950) are described, namely (*a*) a diode in which the resistance is controlled by varying the spacing between the cathodes, the valve thus constituting a variable resistor, (*b*) a triode having a grid midway between the cathodes and functioning as a variable resistor or power oscillator, and (*c*) a diode in which the heated cathode area depends on the current, resulting in stabilization of the voltage between the cathodes. All three types operate direct from 240-V 50-c/s mains.

621.385.2 **1972**

Transit-Time Effects in the Diode under Retarding-Field Conditions.—F. W. Gundlach. (*Philips Res. Rep.*, Dec. 1953, Vol. 8, No. 6, pp. 419–426. In German.) Transit-time effects are taken into account in the calculation of the convection current at the anode. A calculation of the admittance shows the large contribution by electrons which do not reach the anode. Errors in the results of Knol & Diemer (290 of 1953) are noted.

621.385.2 : 537.525.92 **1973**

Approximate Solutions of the Space-Charge Problem for Some Unusual Electrode Geometries.—H. F. Ivey. (*J. appl. Phys.*, Dec. 1953, Vol. 24, No. 12, pp. 1466–1472.) The expressions for the space-charge-limited current for coaxial cylindrical or concentric spherical electrodes are usually given as functions of R/r. By applying the technique suggested by Matricon & Trouvé (1514 of 1951), expressions are obtained for R'/r, where R' is the radius of the equivalent cylindrical or spherical collector and r the radius of the emitter, for 27 different electrode arrangements. The results are tabulated.

621.385.3 **1974**

Development of a New Premium Twin Triode.—H. E. Stumman & J. W. Ritcey. (*RCA Rev.*, Dec. 1953, Vol. 14, No. 4, pp. 482–491.) Description of the construction and manufacturing control of the Type 6101 valve, which is electrically and mechanically interchangeable with the Type 6J6 valve, but is specially designed for reliability.

621.385.832 **1975**

Viewing Storage Tube with Halftone Display.—M. Knoll, P. Rudnick & H. Hook. (*RCA Rev.*, Dec. 1953, Vol. 14, No. 4, pp. 492–501.) The construction and operation is described of a c.r. storage tube of the transmission-control type [3760 of 1953 (Smith & Brown)]. Writing speeds up to 3×10^6 dots/sec and an image persistence of ~10 min for half-tone pictures have been obtained using a pulse restoring method.

621.385 **1976**

Electron Optics. [Book Review]—O. Klemperer. Publishers: Cambridge University Press, 1953, 471 pp., 50s. (*Nature, Lond.*, 30th Jan. 1954, Vol. 173, No. 4396, p. 182.) An authoritative work, for those engaged in design and research in the field of electron optics as well as for physicists working in other fields.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534 + 621.395.61[/.62] : 061.3 **1977**

Proceedings of the First I.C.A. [International Commission on Acoustics] **Congress on Electroacoustics.**—(*Acustica*, 1954, Vol. 4, No. 1, pp. 1–306.) Text of papers presented at the congress held in the Netherlands, June 1953. See also 2855 of 1953.

534.6 : 621.375 **1978**

Use of Variable-Gain Amplifiers in Acoustic Measurements.—A. Moles. (*Rev. gén. Élect.*, Jan. 1954, Vol. 63, No. 1, pp. 35–52.) Two methods of use are distinguished, namely (*a*) for maintaining a constant intensity of sound from the test source, and (*b*) for obtaining response curves of a sound source or detector or of an intervening transmission medium. Applications to the investigation of the acoustics of halls and of the transmission properties of partitions, etc., are described. See also 3767 of 1947.

534.75 : 621.3.018.78 **1979**

The Audibility of Linear Distortion of Natural [musical] **Sounds.**—N. Mayer. (*Funk u. Ton*, Jan. 1954, Vol. 8, No. 1, pp. 1–6.) Subjective tests were made using music reproduced by a loudspeaker associated with a variable-frequency-response amplifier. The least perceptible decrease of the mean amplitude over an octave is 4 db in the medium and high a.f. range and 10 db at the low-frequency end of the range.

534.84 **1980**

Behaviour of Sound in a Room with Absorbent Walls.—S. Eutizi. (*Alta Frequenza*, Feb. 1954, Vol. 23, No. 1, pp. 3–15.) The equation of propagation for a parallelepipedal room with absorbent walls is obtained in a form involving a series expansion, and an explicit third-approximation solution is given for a cubic room. Resonance frequencies and reverberation times are calculated for some examples. An improved formula is derived for calculating Sabine's absorption coefficient.

534.862.4 **1981**

Measurement and Evaluation of the Interference Effect of Noises.—E. Belger. (*Fernmeldetech. Z.*, Jan. 1954, Vol. 7, No. 1, pp. 25–32.) Report of subjective tests of the effect of warbled or interrupted tones and of thermal noise with a bandwidth of a musical third superimposed on reproduced music.

621.395.61 **1982**

Experiments on the Construction of a 'One-Dimensional' Directional Microphone.—G. Kurtze. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st Jan. 1954, Vol. 32, No. 1, pp. 27–31.) An arrangement in which sound arriving from undesired directions is suppressed by interference is achieved by mounting a slotted tube on the front of an ordinary microphone. A modification which is frequency independent within certain limits is also described. Calculated and measured polar diagrams are shown.

621.395.61 : 534.321.9 **1983**

Modulation of Ultrasonic Standing Waves in Air.—L. Pimonow. (*Ann. Télécommun.*, Jan. 1954, Vol. 9, No. 1, pp. 24–28.) Standing waves from a single ultrasonic source may be modulated by a l.f. source, e.g. the human voice. A 'gas-microphone' arrangement based on this principle is described, having 3% modulation depth at 30 kc/s. The device will not operate at frequencies below 15 kc/s. Theory is developed to explain the phenomena.

621.395.623.7 : 534.321.9 **1984**

Marked Demodulation in Air of Two Ultrasonic Waves of Different Frequencies.—S. Klein. (*Ann. Télécommun.*, Jan. 1954, Vol. 9, No. 1, pp. 21–23.) See 958 of April (Maulois).

621.395.625.3 : 621.385.832 **1985**

Investigation of Core Structures for the Electron-Beam Reproducing Head in Magnetic Recording.—J. W. Gratian. (*Trans. Inst. Radio Engrs*, Jan./Feb. 1954, Vol. AU-2, No. 1, pp. 27–38.) An investigation has been made of factors contributing to losses at the upper end of the frequency range in the electron-tube magnetic pickup described by Skellett et al. (11 of January). Strip-type structures have been designed for the external cores; an output of the order of 0·2 V and a frequency range of about 1 c/s–15 kc/s is obtained with a tape speed of 10 in./s.

AERIALS AND TRANSMISSION LINES

621.315.212 **1986**

The Evaluation of Cable Irregularities at Very High Frequencies.—W. W. H. Clarke & J. D. S. Hinchliffe. (*Proc. Instn elect. Engrs*, Part IV, Feb. 1954, Vol. 101, No. 6, pp. 55–60. Digest, *ibid.*, Part III, Jan. 1954, Vol. 101, No. 69, pp. 44–46.) "The magnitude and distribution of cable irregularities are related statistically to the end-to-end input-impedance difference under conditions involving a large number of wavelengths and appreciable attenuation. The manner of variation of the measured quantities with frequency and irregularity magnitude and distribution is revealed. These relationships are shown in the form of master curves for a particular cable on the assumption of exponential fault correlation."

621.372 **1987**

Coupling of Modes of Propagation.—J. R. Pierce. (*J. appl. Phys.*, Feb. 1954, Vol. 25, No. 2, pp. 179–183.) "When two lossless modes of propagation are coupled, waves which increase or decrease with distance may arise when the power flow of the two modes is in opposite directions or when power is generated in the coupling device. This behavior is characteristic of wave filters, traveling-wave tubes, double-stream amplifiers, and space-charge-wave amplifiers. Such behavior is analysed assuming linearity and conservation of energy only."

621.372.2 **1988**

Designing Surface-Wave Transmission Lines.—G. Goubau. (*Electronics*, April 1954, Vol. 27, No. 4, pp. 180–184.) The theory of the surface-wave line is outlined and the effects of precipitation are discussed. Measurements have been made at about 250 Mc/s on a 2-mile line with a loss of 6 db per mile, and at about 2 kMc/s on a 130-ft aerial feeder line with a total loss of about 2 db. Design graphs are given for lines using polyethylene-coated Cu wire. Launching loss is also considered; best results were obtained using a horn with an inner conductor tapering down to the line diameter.

621.372.2 : 621.396.67 **1989**

Foundations of an Exact Theory of the Wave Field of a Transmission Line.—G. A. Grinberg & B. E. Bonshtedt. (*Zh. tekh. Fiz.*, Jan. 1954, Vol. 24, No. 1, pp. 67–95.) The propagation of e.m. waves along a straight conductor of circular cross-section, located above and parallel to the surface of a plane homogeneous earth is considered theoretically. The exact solution is derived first, then approximate solutions are found and the effect of the earth on the field above it is calculated. The complex velocity of propagation along the conductor, the effective parameters of the line and wave field near the earth are also calculated. The solutions by Sommerfeld, Mie, Pollaczek (*Elekt. NachrTech.*, 1927, Vol. 4, pp. 295–304 & 515–525) and others are briefly discussed.

621.372.2.029.64 **1990**

Microstrip — A New Transmission Technique for the Kilomegacycle Range.—D. D. Grieg & H. F. Engelmann. (*Proc. Instn Radio Engrs, Aust.*, Jan. 1954, Vol. 15, No. 1, pp. 13–19.) Reprint. See 621 of 1953.

621.372.8 **1991**

Transmission and Matching Theory of Homogeneously Guided Waves.—F. J. Tischer. (*Arch. elekt. Übertragung*, Jan. & Feb. 1954, Vol. 8, Nos. 1 & 2, pp. 8–14 & 75–84.) Mathematical expressions for propagation in waveguide systems are derived directly from Maxwell's equations. The orthogonal curvilinear coordinate system is used. Particular cases considered include propagation in cylindrical systems and the effects of terminations, inhomogeneities, discontinuities and coupling.

621.372.8 **1992**

Propagation of Microwaves through a Cylindrical Metallic Guide filled Coaxially with Two Different Dielectrics: Part 4.—S. K. Chatterjee. (*J. Indian Inst. Sci.*, Section B, Jan. 1954, Vol. 36, No. 1, pp. 1–13.) The field components and propagation constants for hybrid modes are derived theoretically. Part 3: 1671 of June.

621.372.8 **1993**

Representation of the Electromagnetic Field in a Waveguide with Absorbent Walls.—M. De Socio. (*R. C. Accad. naz. Lincei*, Jan. 1954, Vol. 16, No. 1, pp. 63–68.) Analysis is given for a system comprising plane parallel conductors with a homogeneous dielectric filling the space between them. The field can be represented by two superimposed evanescent plane waves, of which the one can be considered as the reflection of the other at the walls of the interspace.

621.396.67 **1994**

Radiation Resistance and Gain of Homogeneous Ring Quasi-Array.—H. L. Knudsen. (*Proc. Inst. Radio Engrs*, April 1954, Vol. 42, No. 4, pp. 686–695.) Continuation of analysis presented previously (2570 of 1953). Ring arrays of tangential or radial dipoles are considered. To simplify the calculation of gain and radiation resistance the number of dipoles is assumed to be infinite. The method of calculation is similar to that of Foster (46 of 1945), who investigated the particular case of constant phase round the ring, and is also related to that of Page (1862 of 1948) for axial dipoles.

621.396.676 **1995**

Designing Flush Antennas for High-Speed Aircraft.—J. V. N. Granger. (*Electronics*, March 1954, Vol. 27, No. 3, pp. 136–140.) A general discussion of the design problems encountered.

621.396.677.3.091.22 **1996**

A New Method of Measuring the Gain of Linear-Array Antennas.—S. Uda & Y. Mushiake. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, Dec. 1952, Vol. 4, No. 1, pp. 51–65.) A method of calculating the gain of linear aerials from the measured radiation patterns in the equatorial plane is briefly described. The necessary formulae, which involve sine power-series and use of Simpson's summation rule, are derived. An alternative graphical method is indicated. The methods are particularly applicable to the Yagi-Uda type aerial.

621.396.677.4 **1997**

Radiation from a Ground Antenna.—J. R. Wait. (*Canad. J. Technol.*, Jan. 1954, Vol. 32, No. 1, pp. 1–9.) Theory of the wave aerial is developed and possible alternative modes of operation are discussed. Curves are presented for determining radiation characteristics.

621.396.677.8 : 538.52 : 537.311.5 **1998**

On the Current induced in a Conducting Ribbon by a Current Filament Parallel to it.—E. B. Moullin. (*Proc. Instn elect. Engrs*, Part IV, Feb. 1954, Vol. 101, No. 6, pp. 7–17.) Full paper. See 704 of March.

621.396.677.832 **1999**

Measurements on Corner-Reflector Aerials.—G. Burkhardt. (*Fernmeldetech. Z.*, Feb. 1954, Vol. 7, No. 2, pp. 55–56.) Curves are presented showing variation of gain with distance a between dipole and vertex, at 50–70 cm λ, for 60° and 72° corner-reflector aerials, for values of a up to 2λ and $1{\cdot}6\lambda$ respectively. For wide-band aerials a reflector angle of 72° is better than one of 60° or 90° because the gain variation is not so great. See also 2224 of 1953 (Harris).

621.396.677.85 2000

Tolerances in Parameters of Microwave Lenses.—D. H. Shinn & T. C. Cheston. (*Marconi Rev.*, 1st Quarter 1954, Vol. 17, No. 112, pp. 1–9.) Lenses comprising metal plates or square metal tubes are considered. Formulae for the constructional and electrical tolerances derived by Risser (*Microwave Antenna Theory and Design*, chapter 11) are generalized and extended. Some consistent errors can be corrected by refocusing. Tolerances in phase-corrected reflectors are treated in an appendix.

621.396.677.85 2001

Secondary Beams from Metal Lenses.—T. C. Cheston. (*Marconi Rev.*, 1st Quarter 1954, Vol. 17, No. 112, pp. 10–15.) Microwave lenses of parallel-plate or square-tube type are considered, and the conditions for the occurrence of secondary beams are derived using diffraction-grating theory. A sphero-ellipsoidal lens is less liable to generate secondary beams than is a plano-ellipsoidal or a plano-hyperboloidal lens. For scanning over wide angles it is impractical to design lenses free from secondary beams, because the required low value of refractive index is undesirable from the point of view of matching.

AUTOMATIC COMPUTERS

681.142 2002

Partial Drift Compensation in Electronic D.C. Analog Computers for Differential Equations.—L. E. Löfgren. (*Appl. sci. Res.*, 1954, Vol. B4, Nos. 1/2, pp. 109–123.) A method particularly suitable for computers with time-shared elements is described. The number of compensation points can be much smaller than the number of drift sources. The method is illustrated by describing the compensation of a machine for computing direction cosines.

681.142 2003

Analog Computing by Heat Transfer.—P. H. Savet. (*Tele-Tech*, Feb. 1954, Vol. 13, No. 2, pp. 101, 122.) Multiplier, divider, a.c. integrating and differentiating circuits are described, based on the use of a thermal transducer. This transducer consists basically of a pair of heater elements each one of which is in thermal contact with one of a pair of temperature sensing elements mounted in a Wheatstone bridge circuit. Appropriate application to the heater elements of two electrical input signals creates a temperature difference proportional to their product between the sensing elements.

681.142 2004

FOSDIC — A Film Optical Sensing Device for Input to Computers.—(*Tech. News Bull. nat. Bur. Stand.*, Feb. 1954, Vol. 38, No. 2, pp. 24–27.) An instrument is described for processing written records, such as answers to questionnaires. Marks made with ordinary pen or pencil at special locations on microfilm are converted into electrical pulses, by means of a flying-spot scanning system. The pulses are recorded on magnetic tape for input to the computer. See also *Tele-Tech*, Feb. 1954, Vol. 13, No. 2, pp. 78–79..140.

681.142 2005

Fast-Acting Digital Memory Systems.—I. L. Auerbach. (*Elect. Mfg*, Oct. & Nov. 1953, Vol. 52, Nos. 4 & 5, pp. 100–107 & 136–143.) A survey of moderate- and high-speed storage techniques for digital computers.

681.142 : 538.221 2006

Penetration of an Electromagnetic Wave into a Ferromagnetic Material.—A. Papoulis. (*J. appl. Phys.*, Feb. 1954, Vol. 25, No. 2, pp. 169–176.) An investigation of the magnetization of metallic-ribbon toroidal cores with rectangular hysteresis loop, used as computer storage elements. Approximate solutions are obtained for the field inside the core under different conditions of loading. Theoretical and experimental output waveforms show close agreement for high magnetizing force and thickness of core material $> 0{\cdot}5$ mil.

681.142 : 538.221 : 621.318.134 2007

Ferromagnetic Spinels with Rectangular Hysteresis Loops.—I. J. Hegyi. (*J. appl. Phys.*, Feb. 1954, Vol. 25, No. 2, pp. 176–178.) Tests made on materials of different composition show $MgO.3MnFe_2O_4$ to be most suitable for magnetic storage elements. For rings of outside diameter 55 mil, inside diameter 35 mil, the coercive force is about 3 oersteds and switch-over time $0{\cdot}3\ \mu$s. Rings of 0·5-cm outside diameter have a lower coercive force.

681.142 : 621-526 2008

Servo Control of the Position and Size of an Optical Scanning System.—T. Kilburn & E. R. Laithwaite. (*Proc. Instn elect. Engrs*, Part IV, Feb. 1954, Vol. 101, No. 6, pp. 129–134.) "A method of controlling the position and size of a television-type raster relative to arbitrary references by means of four servo mechanisms is described. One of the applications of such a system is that of a reading device for punched cards. A system for reading any one of a stack of cards without removing the selected card has been developed using the servo-controlled raster. The design of the servo mechanisms for this application is described in detail."

681.142 : 621.3 (084.2) 2009

Electronic-Circuit Technique for a High-Speed Computer.—G. Piel. (*Onde élect.*, Jan. 1954, Vol. 34, No. 322, pp. 38–46.) Commonly used computer-circuit units based on a triode or Ge diode are represented by a symbol indicating the unit and its mode of operation. The functions of different combinations of the basic units are listed and their application in a serial binary-scale computer is illustrated using the notation described.

681.142 : 621.318.572 2010

New Flip-flop Chain Circuits used in Computers for counting to Base 10 and Base 12.—J. J. Bruzac. (*Onde élect.*, Jan. 1954, Vol. 34, No. 322, pp. 59–62.) Modifications to the Potter decade arrangement are described.

681.142 : 621.372 2011

An Improved Experimental Iteration Method for Use with Resistance-Network Analogues.—G. Liebmann & R. Bailey. (*Brit. J. appl. Phys.*, Jan. 1954, Vol. 5, No. 1, pp. 32–35.) A development of the method previously described by Liebmann (2839 of 1952). The error signals for a number of network nodes are displayed simultaneously on a c.r.-tube screen, so that it is always possible to work on the worst error instead of making adjustments cyclically.

681.142 : 621.374.5 2012

The Mercury-Delay-Line Storage System of the Ace Pilot Model Electronic Computer.—E. A. Newman, D. O. Clayden & M. A. Wright. (*Proc. Instn elect. Engrs*, Part II, Feb. 1954, Vol. 101, No. 79, p. 65.) Discussion on 61 of January.

681.142 : 621.375.2.024 2013

Time-Shared Amplifier stabilizes Computers.—D. W. Slaughter. (*Electronics*, April 1954, Vol. 27, No. 4, pp. 188–190.) Drift in the d.c. operational amplifiers of analogue computers is reduced by connecting them periodically to the output of an auxiliary stabilizing

amplifier. The advantages of using a direct-coupled rather than a chopper type of amplifier for this purpose are indicated. Circuit details are described, including the switching and filtering arrangements.

CIRCUITS AND CIRCUIT ELEMENTS

534.321.9 : 534.213 : 621.396.6 **2014**

Metal Ultrasonic Delay Lines.—R. W. Mebs, J. H. Darr & J. D. Grimsley. (*J. Res. nat. Bur. Stand.*, Nov. 1953, Vol. 51, No. 5, pp. 209–220.) An experimental investigation was made with the object of finding a metal or alloy suitable for the transmission of 10-Mc/s pulses at temperatures between −50°C and + 200°C with a delay < 50 μs independent of temperature. The effect of various constructions, crystal attachment methods and materials, and treatment of the delay-line material was investigated; the results are tabulated and shown graphically. An isoelastic iron alloy containing ~ 36% Ni, 7–8% Cr and other minor constituents, used with overcured epoxy-resin quartz-crystal attachments, gave the best transmission characteristics. A shorter account of the work is given in *Tech. News Bull. nat. Bur. Stand.*, March 1954, Vol. 38, No. 3, pp. 38–39.

621.3.015.3 : 517.942.82 **2015**

The Calculation of Transients in Dynamical Systems.—Ward. (See 2163.)

621.3.018.75 : 621.387.4 **2016**

A Stable High-Speed Multichannel Pulse Analyzer.—E. Gatti. (*Nuovo Cim.*, 1st Feb. 1954, Vol. 11, No. 2, pp. 153–162. In English.) Pulse selection in each channel is accomplished by a single discriminator whose threshold is set at a height corresponding to the upper boundary of the channel, the channel width being determined by suitably shaping the incoming pulses.

621.316.726.029.6 : 621.376.3 **2017**

Frequency Discrimination and Stabilization of Square-Wave Modulated Microwave Transmissions.—C. H. M. Turner. (*Proc. Instn elect. Engrs*, Part IV, Feb. 1954, Vol. 101, No. 6, pp. 61–72.) Full paper. See 652 of March.

621.316.729 **2018**

Pulling Effect in Synchronized Systems.—Z. Jelonek, O. Celinski & R. Syski. (*Proc. Instn elect. Engrs*, Part IV, Vol. 101, No. 6, pp. 108–117. Digest, *ibid.*, Part III, Vol. 101, No. 69, pp. 50–52.) Synchronization of a valve oscillator with a low-pass filter in the feedback loop is considered, and the phase-equation method of analysis applied, with parameters M and T, proportional to the detuning and to the filter time-constant respectively. For $|M| < 1$, the operating point lies within the synchronization range, but the system remains in the asynchronous state (i.e., pulling effect exists) for values of $|M|$ greater than a critical value M_0. For $|M| < M_0$ the system is synchronized, and, if this is an initial condition of the system, synchronization will be maintained for values of $|M|$ up to unity. A graph of the pulling function, i.e., the relation between M_0 and T, obtained in part by analysis, in part from experiment, is shown. The case of a limiter in the feedback loop is also considered.

621.316.8.029.5 **2019**

The Design of a Radio-Frequency Coaxial Resistor.—C. T. Kohn. (*Proc. Instn elect. Engrs*, Part IV, Feb. 1954, Vol. 101, No. 6, pp. 146–153. Digest, *ibid.*, Part III, Jan. 1954, Vol. 101, No. 69, pp. 48–50.) Characteristics of the cylindrical coaxial resistor, intended for use as a reflection-free termination, are discussed and design curves given. The jacket diameter is chosen to maintain the resistive component of the resistor at the required value. The reactive component may be compensated in two ways. The first, suitable for resistor lengths $< 0{\cdot}08\lambda$, consists in undercutting the line. The second requires the insertion of a short-circuited transmission line in series with the resistor, and will give either perfect compensation over a restricted frequency range, or less accurate compensation over a wider range. The effect of the holder is taken into account.

621.318.4 **2020**

Iron-free Cylindrical Coils with Reduced External Field.—G. Kirschstein. (*Arch. Elektrotech.*, 1954, Vol. 41, No. 4, pp. 222–230.) The design of coils with zero magnetic moment is described and the necessary formulae are given. The arrangement consists of three coaxial coils connected so that the outer coil produces a field opposing that of the two inner coils and of such magnitude as to reduce the external field to nearly zero. The internal field is approximately equal to that of the innermost coil alone. Coils of this type are useful, e.g., for focusing electron beams, for magnetic measurements and for inductance standards. See also *Phys. Z.*, 15th Feb. 1940, Vol. 41, Nos. 3/4, pp. 53–55 (Steinhaus & Kussmann).

621.318.423 **2021**

Design of High-Frequency Coils for High Currents.—E. Karger. (*Funk u. Ton*, Jan. 1954, Vol. 8, No. 1, pp. 7–18.) A practical guide to the design of single-layer air-cored cylindrical coils and a short-circuit variometer. The dissipation of heat, electrical breakdown potential, and the various losses are considered. Formulae, tables and an inductance/coil-dimensions nomogram are given.

621.319.4 **2022**

The Performance of Dried and Sealed Mica Capacitors.—G. H. Rayner & L. H. Ford. (*J. sci. Instrum.*, Jan. 1954, Vol. 31, No. 1, pp. 3–6.) Good stability has been achieved in an 0·01-μF capacitor by drying it for a year and then mounting it in a sealed container. The interdependence of the variations of capacitance and power factor over the frequency range 10 c/s–10 kc/s is discussed.

621.319.45 **2023**

Tantalum Electrolytic Capacitors.—Nguyen Thien-Chi & J. Vergnolle. (*Ann. Radioélect.*, Jan. 1954, Vol. 9, No. 35, pp. 83–97.) A general review of types of electrolytic capacitors and problems of design, manufacture and testing of Ta types. Data are presented for three C.S.F. capacitors, having volumes of 1·7, 1·1 and 0·5 cm³, with average capacitances of 50, 25 and 12 μF respectively at 70-V operation.

621.372 **2024**

Normalization of the Frequency Dependence of Impedance and Amplifier Circuits: Outline of Generalized Circuit Theory.—K. H. R. Weber. (*NachrTech.*, Jan. 1954, Vol. 4, No. 1, pp. 13–19.)

621.372 : 517.63 **2025**

Some Observations on Time considered as a Complex Variable.—E. C. Cherry. (*Onde élect.*, Jan. 1954, Vol. 34, No. 322, pp. 7–13.) Results of applying this concept in Fourier and Laplace transformations are examined, and its application to the analysis of transients is discussed. A practical interpretation of reversing the real-time/complex-frequency relation is given with reference to echo phenomena.

621.372 : 621.314.7 **2026**

The Transistor as a Network Element.—J. T. Bangert. (*Bell Syst. tech. J.*, March 1954, Vol. 33, No. 2, pp. 329–352.) The use of transistors for (*a*) reduction of dissipation, (*b*) elimination of inductance, (*c*) production of

delay, ($\bar{d}$) inversion of impedance is discussed. Improvements in performance can be achieved which would otherwise be unobtainable or uneconomic.

621.372 : 621.396.822 : 530.162 **2027**

The Brownian Movement of Linear and Nonlinear Systems.—D. K. C. MacDonald. (*Phil. Mag.*, Jan. 1954, Vol. 45, No. 360, pp. 63–68.) The application of Brownian-movement analysis to systems with a nonlinear relaxation mechanism (e.g., electrical conductivity) is considered. A statistical hypothesis is proposed which enables a calculation to be made of the Brownian movement and corresponding frequency spectrum of such systems. The results are relevant to the study of electrical noise.

621.372 : 621.396.822 : 530.162 **2028**

Note on the Theory of Brownian Motion in Nonlinear Systems.—D. Polder. (*Phil. Mag.*, Jan. 1954, Vol. 45, No. 360, pp. 69–72.) The hypothesis advanced by MacDonald (2027 above) is shown to be not self-consistent.

621.372.5 **2029**

A New Method of Synthesis of Reactance Networks.—A. Talbot. (*Proc. Instn elect. Engrs*, Part IV, Feb. 1954, Vol. 101, No. 6, pp. 73–90. Digest, *ibid.*, Part III, Jan. 1954, Vol. 101, No. 69, pp. 46–48.) Since the chain matrix of a cascade combination of quadripoles is the product of the individual chain matrices, and since synthesis of a complicated network by the insertion-loss method involves obtaining a number of simple sections to be connected in cascade, the chain matrix is chosen for this purpose. A method of factorizing any realizable chain matrix into two such matrices of lower order is presented. Repeated factorizations ultimately yield sections simple enough to be synthesized. The method involves only simple algebra and a new theorem concerning reactance and impedance functions.

621.372.5 **2030**

Lumped-Parameter Delay Lines.—H. Feissel. (*Onde élect.*, Jan. 1954, Vol. 34, No. 322, pp. 53–58.) The application of rigorous filter theory to delay lines comprising a series of coaxial coils is difficult owing to the coupling between nonadjacent coils. An experimental method of obtaining frequency characteristics is outlined. The latter can be corrected by connecting a capacitor across adjacent coils. Filter theory is applied to give an indication of suitable capacitance values.

621.372.5 : 621.3.015.3 **2031**

Monotonic Transient Response.—O. P. D. Cutteridge. (*Proc. Instn elect. Engrs*, Part IV, Feb. 1954, Vol. 101, No. 6, pp. 46–54. Digest, *ibid.*, Part III, Jan. 1954, Vol. 101, No. 69, pp. 43–44.) Restrictions are derived which must be placed on the poles and zeros of the system function of a linear system with lumped constants in order that the response of the system to a step-function drive shall be monotonic. System functions having up to three zeros are considered. A method of dealing with systems containing more than three zeros is explained.

621.372.5 : 621.3.018.78 **2032**

Distortion of Arbitrarily Shaped Curves by *RC* Sections.—E. William. (*Funk u. Ton*, Jan. & Feb. 1954, Vol. 8, Nos. 1 & 2, pp. 30–46 & 87–99.) A method is given of calculating the distortion by an *RC* network of any signal which is expressible as the sum of a power series and terms containing exponential functions of the circuit time constants. Tables and nomograms are given for calculating the output form given the input curve, and vice versa, for rectangular, trapezoidal, triangular, parabolic and exponential-type pulses.

621.372.51 : 621.396.67 **2033**

Matching Circuits for Asymmetrical Wire Aerials.—A. Simon. (*Frequenz*, Feb. 1954, Vol. 8, No. 2, pp. 48–56.) A comparison of various types of aerial coupling circuits used particularly at medium and long wavelengths, and of the ease of adjustment for use at different frequencies. The discussion shows that the most advantageous circuits consist of two variable reactances used in conjunction with an impedance meter. Examples of this type for use at 1·5–12 Mc/s or at medium waves are shown.

621.372.512 **2034**

Action of Periodic Telegraphy Signals on Cascaded *RLC* Resonant Circuits.—J. Marique. (*Rev. HF, Brussels*, 1954, Vol. 2, No. 9, pp. 233–244.) The response to rectangular, trapezoidal and sine-squared pulses of a cascaded arrangement of up to three similar tuned circuits is investigated theoretically and the results compared with the response of a single tuned circuit (3241 of 1953). The effect of bandwidth and signal repetition frequency is studied from the point of view of using the circuit for Fourier analysis and for reception of telegraphy.

621.372.54 **2035**

Explicit Formulae for the Calculation of Filter Circuits with Generalized Parameters.—V. Fetzer. (*Arch. elekt. Übertragung*, Jan. 1954, Vol. 8, No. 1, pp. 31–46.) An extension of previous work (1545 of 1952) to the antimetrical low-pass, the symmetrical and the antimetrical band-pass characteristic functions and the determination of the transmission factor.

621.372.54 **2036**

The Smoothing of Loss Attenuation in Basic Types of Ladder Filter.—H. Matthes. (*Frequenz*, Dec. 1953, Vol. 7, No. 12, pp. 360–368 & Jan. 1954, Vol. 8, No. 1, pp. 17–28.) The characteristics of basic and terminating half-sections with losses are derived from image-parameter theory, and the results applied to show how the attenuation can be smoothed by introducing mismatch at the end of the filter or by inserting series and/or shunt resistors at properly chosen points within the network.

621.372.54 : 621.3.015.3 **2037**

The Transient Response of R.F. and I.F. Filters to a Wave Packet.—A. W. Gent. (*Proc. Instn elect. Engrs*, Part IV, Feb. 1954, Vol. 101, No. 6, p. 164.) Discussion on 963 of 1953.

621.372.56 **2038**

A Stable Voltage-Controlled Logarithmic Attenuator.—G. E. Boggs. (*Proc. Inst. Radio Engrs*, April 1954, Vol. 42, No. 4, pp. 696–700.) The variable-impedance element is a triode operated so that the cathode impedance varies approximately inversely as the transconductance. Stabilization is achieved by the use of d.c. feedback with a suitable increase in loop gain. Design procedure is given for both high- and low-input types. Experimental results are discussed.

621.372.6 **2039**

Design of *RC* Wide-Band 90-Degree Phase-Difference Network.—D. K. Weaver, Jr. (*Proc. Inst. Radio Engrs*, April 1954, Vol. 42, No. 4, pp. 671–676.) The arrangement comprises two all-pass networks, as described by Orchard (1356 of 1950). The pole-zero pairs are first determined so as to give the 90° difference of phase shift over the frequency band, and the networks are synthesized from the response functions thus found. Design procedure is detailed step by step and is illustrated by a numerical example. Notes on construction and alignment are included.

621.372.8 : 538.614 **2040**

A Nonreciprocal Microwave Component.—M. L. Kales, H. N. Chait & N. G. Sakiotis. (*J. appl. Phys.*, June 1953, Vol. 24, No. 6, pp. 816–817.) In the presence of a steady magnetic field the permeability of a ferrite is an asymmetrical tensor. This property is applied in the construction of a nonreciprocal device comprising a waveguide in which a ferrite block is arranged asymmetrically and parallel to the axis, a static magnetic field being applied transversely. Experimental results are given.

621.373.4 **2041**

Valve Oscillators with Voltage-Controlled Frequency Dependence.—H. Wilde. (*Frequenz*, Jan. 1954, Vol. 8, No. 1, pp. 1–7.) A discussion of various circuits in which reactance is varied by application of control voltage, and a comparison of their performance in respect of bandwidth and output at medium and high frequencies.

621.373.42 **2042**

Ultra-Low-Frequency Three-Phase Oscillator.—G. Smiley. (*Proc. Inst. Radio Engrs*, April 1954, Vol. 42, No. 4, pp. 677–680.) An oscillator for the frequency range 0·01 c/s–1 kc/s uses three identical networks each comprising a polystyrene capacitor and a stable resistor, in a star arrangement radiating from the power supply. The circuit is in effect a three-stage amplifier, oscillations occurring at the frequency for which the phase shift is 60° in each *RC* network. Use is made of the Miller effect to keep down the size and cost of the frequency-determining elements.

621.373.42.029.55/.62 : 621.318.572 **2043**

Electronically-Tuned Wide-Range Oscillator.—D. D. King & R. L. Konigsberg. (*Electronics*, March 1954, Vol. 27, No. 3, pp. 184–186.) A helical transmission line with Ge diodes mounted at intervals of $\lambda/4$ is used as tuning element in a Colpitts circuit. Tuning is accomplished by applying a switching pulse to a selected diode to short the line. The five tuning positions give frequencies of about 8·6, 14, 22, 34 and 46 Mc/s respectively. The length of helical line required is very much less than that of a parallel-conductor line for the same frequency. Satisfactory operation of an experimental model was achieved at switching rates up to 1 000 pulses/sec.

621.373.421 **2044**

Perturbations of a Nonlinear Filtered Oscillator.—G. Cahen. (*Onde élect.*, Jan. 1954, Vol. 34, No. 322, pp. 80–89.) Analysis, summarized earlier (1279 and 1624 of 1953), of the effect of a disturbance on the behaviour of an oscillator comprising a nonlinear amplifier, feedback loop and low-pass filter. See also 972 of 1953 (Cahen & Loeb).

621.373.421.029.4/.51 **2045**

Audio Oscillator uses New *RC* Design.—J. H. Owens. (*Electronics*, March 1954, Vol. 27, No. 3, pp. 176–177.) A signal generator covering the range 11 c/s–100 kc/s in four bands has both low-pass and high-pass *RC* filters incorporated in the feedback loop to give good frequency stability and good waveform. Amplified a.g.c. is included in a commercial adaptation of the circuit.

621.374 : 621.314.632 : 546.289 **2046**

"Positive-Gap" Germanium Diode.—Reeves. (See 2256.)

621.374 : 621.396.82 **2047**

Noise Discriminator for Periodic Signals.—R. L. Conger & L. E. Schilberg. (*Rev. sci. Instrum.*, Jan. 1954, Vol. 25, No. 1, pp. 52–54.) The periodic signal, of any waveform, is applied through a phase inverter to one pair of terminals of a resistance bridge including two diode rectifiers. Periodic pulses are applied to the other pair of bridge terminals. During each pulse the diodes are unblocked and the signal passes to an integrating circuit with an adjustable time constant. If the pulse frequency is slightly greater than the signal frequency the output obtained has the waveform of the noise-free input signal and a much lower frequency; random noise, mains interference and any other disturbance of a frequency which is not a multiple of the signal frequency will not be reproduced. The unit was designed for use with nuclear magnetic resonance apparatus.

621.374.4 : 621.373.421.13 **2048**

Subharmonic Crystal Oscillators.—M. O. Thompson, Jr, C. E. Tschiegg & M. Greenspan. (*Rev. sci. Instrum.*, Jan. 1954, Vol. 25, No. 1, pp. 8–12.) The operating frequency of a relaxation oscillator can be stabilized at a submultiple of a crystal frequency. In a conventional blocking oscillator with a crystal connected across the third winding of the pulse transformer, frequency division by factors up to several thousand can be effected. A multivibrator with crystal between anode and grid of one valve gave good frequency and pulse-width stability when operating with a division factor of 100. Details of these two circuits are given; three others have been examined, namely a screen-coupled-phantastron, a thyratron and a transistor circuit.

621.375 : 534.6 **2049**

Use of Variable-Gain Amplifiers in Acoustic Measurements.—Moles. (See 1978.)

621.375.132.018.78 **2050**

Harmonic Distortion and Negative Feedback.—E. E. Zepler. (*Wireless Engr*, May 1954, Vol. 31, No. 5, pp. 118–121.) Different methods of defining gain in relation to the output-voltage/input-voltage characteristic of an amplifier are discussed; for a nonlinear amplifier it is reasonable to base the definition on the average slope. A method is indicated for constructing the characteristic of the amplifier with feedback from that of the amplifier without. Distortion can be reduced by means of feedback even for flat regions of the characteristic; this result is in disagreement with that of Rowlands (2278 of 1953). Detailed analysis is given for several types of amplifier.

621.375.2.018.75 : 621.373.431.1 **2051**

Application of the Multivibrator Principle in Counter-Tube Amplifiers.—W. Kroebel & G. Stutzer. (*Z. angew. Phys.*, Jan. 1954, Vol. 6, No. 1, pp. 14–19.) A description is given of a pulse amplifier based on a multivibrator circuit, which gives an output pulse of amplitude 180 V with a leading-edge slope of $1{\cdot}1 \times 10^{-9}$ sec/V for a 0·3-mV input pulse.

621.375.222 **2052**

Cathode-Coupled Valves.—T. W. Brady. (*Wireless Engr*, May 1954, Vol. 31, No. 5, pp. 111–114.) A graphical method is described for investigating cathode-coupled amplifiers. The method is demonstrated in relation to a circuit using a Type-ECC33 twin triode, and involves the construction of composite load lines on the anode characteristics. An initial trial solution must be found to determine the voltage across the cathode resistor in the quiescent case.

621.375.232.3 **2053**

An A.C. Cathode-Follower Circuit of Very High Input Impedance.—J. R. Macdonald. (*Rev. sci. Instrum.*, Feb. 1954, Vol. 25, No. 2, pp. 144–147.) A push-pull amplifier for the range 10^2–10^4 c/s is described. Each half of the input consists of a cathode follower with gain approxi-

mately unity with a constant-current cathode load constituted by a further valve. The effect of grid-anode capacitance in the input valve is reduced by driving the anode by another cathode follower in series with it. Input capacitance is $< 0{\cdot}3$ pF and input resistance $> 4 \times 10^9\Omega$ up to 3·2 kc/s. Circuit modifications to obtain zero or negative input capacitance are explained.

621.375.3 **2054**

Flux Preset High-Speed Magnetic Amplifiers.—C. B. House. (*Elect. Engng, N.Y.*, Jan. 1954, Vol. 73, No. 1, p. 51.) Digest of paper to be published in *Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72.

621.375.3 **2055**

Parallel-Connected Magnetic Amplifiers.—S. H. Chow. (*J. appl. Phys.*, Feb. 1954, Vol. 25, No. 2, pp. 216–221.) A complete analysis, based on a single-valued B/H relation, is made for three types of load: resistive, inductive and capacitive. Transient response is considered. Analysis of feedback amplifiers shows clearly the 'jump' phenomenon in the output characteristic.

621.375.4 **2056**

High-Frequency Transistor Amplifiers.—W. F. Chow. (*Electronics*, April 1954, Vol. 27, No. 4, pp. 142–145.) Transistor equivalent circuits appropriate for h.f. wide-band operation are presented. Input and output impedance and power gain for grounded-base and grounded-emitter arrangements are discussed. The design of an i.f. amplifier using four *n-p-n* transistors is described as an example; the bandwidth is 14 kc/s centred at 455 kc/s, and the gain is 18 db per stage.

621.375.4 **2057**

Transistor Equations using h-Parameters.—C. C. Cheng. (*Electronics*, April 1954, Vol. 27, No. 4, pp. 191–192, 194.) Transistor circuit calculations are simplified by making use of fundamental parameters for the four-terminal network corresponding to the base-input common-emitter circuit. Circuit equations in terms of these parameters are tabulated for the three basic configurations.

621.375.4 **2058**

Practical Two-Stage Transistor Amplifiers.—R. L. Riddle. (*Electronics*, April 1954, Vol. 27, No. 4, pp. 169–171.) The effects of feedback and choice of coupling circuits are discussed. Experimentally determined operating characteristics are presented for the three most useful arrangements, (*a*) grounded-emitter to grounded-emitter, (*b*) grounded-base to grounded-emitter, and (*c*) grounded-collector to grounded-emitter, using commercially available junction transistors.

621.375.4 **2059**

Design of Transistor Power Amplifiers.—S. K. Ghandhi. (*Electronics*, March 1954, Vol. 27, No. 3, pp. 146–149.) Methods are outlined for obtaining maximum power output consistent with acceptable distortion. Factors considered include stage gain and power supply. Using values obtainable with the GE2N34 *p-n-p* transistor, two numerical examples are worked out, (*a*) a class-A push-pull grounded-base arrangement for a 100-mW low distortion a.f. amplifier, and (*b*) a class-B grounded-emitter arrangement for a 300-mW output stage.

621.375.4.024 **2060**

Temperature-Compensated D.C. Transistor Amplifier.—E. Keonjian. (*Proc. Inst. Radio Engrs*, April 1954, Vol. 42, No. 4, pp. 661–671.) The variation of transistor parameters with temperature is discussed. Compensation can be provided by using temperature-sensitive resistors. A description is given of an experimental d.c. amplifier compensated in this way. See also 1367 of May.

621.376.5 : 621.385.029.6 **2061**

Pulse Formation and Supply for Magnetrons.—H. G. Bruijning. (*Tijdschr. ned. Radiogenoot.*, Jan. 1954, Vol. 19, No. 1, pp. 11–23.) Discussion of the design of a modulator capable of handling pulses of the order of 30 A at 30 kV with a duration of 1 μs and a repetition rate of 1 000 per sec. The method of pulse formation used is based on the slow charging and rapid discharging of a capacitor. The use of artificial lines for pulse shaping is described. If a pulse transformer is used, the charging voltage need not be unduly high.

621.396.6 **2062**

Trends of Development in the Field of Electrical Components for Telecommunication.—P. Henninger. (*Frequenz*, Dec. 1953, Vol. 7, No. 12, pp. 345–359, & Jan. 1954, Vol. 8, No. 1, pp. 7–17.) Component design is considered from the point of view of the physics and chemistry involved in meeting the requirements of (*a*) operation over a particular frequency band, (*b*) operation under conditions of prescribed current waveform and intensity, (*c*) operation under peak loads, (*d*) operation at low loss, (*e*) operation under given ambient conditions, (*f*) operation under restrictions of tolerance, (*g*) stability and durability.

621.396.6 : 061.4 **2063**

Components Exhibition. Trends in Developments Portrayed at the R.E.C.M.F. Show.—(*Wireless World*, May 1954, Vol. 60, No. 5, pp. 206–210.) A review of the exhibition held in London, April 1954.

621.396.6.002.2 **2064**

Printed-Circuit Design Sources.—(*Elect. Mfg*, Dec. 1953, Vol. 52, No. 6, pp. 129–132..316.) A detailed guide to commercial design and manufacturing sources available in the U.S.A.

621.396.6.002.2.001.4 **2065**

Standardization of Printed Circuit Materials.—W. Hannahs, J. Caffiauz & N. Stein. (*Tele-Tech*, Feb. 1954, Vol. 13, No. 2, pp. 68–70..155.) Results of tests on metal-clad plastic laminates for (*a*) thermal endurance under simulated manufacturing conditions, (*b*) adhesion variation between the centre and the edge of the sheet, (*c*) bond strength during solder dipping and hand soldering, (*d*) effects of dust, are shown graphically. These and other types of bond-strength tests are discussed from the point of view of establishing quality standards and standard conditions of test. The positioning of components to avoid bond stress, and the proper choice of operating temperatures are also considered.

GENERAL PHYSICS

537.122 **2066**

A Theory of the Electron.—H. T. Flint & E. M. Williamson. (*Nuovo Cim.*, 1st Feb. 1954, Vol. 11, No. 2, pp. 188–199. In English.) An essentially classical theory is proposed by analogy with the gravitational theory of matter; it is based on equations of the form suggested by Mie in 1912. The mass of the electron is accounted for by means of the energy of the field.

537.311.5 : 621.3.015.3 **2067**

Diffusion of Pulsed Currents in Conductors.—L. M. Vallese. (*J. appl. Phys.*, Feb. 1954, Vol. 25, No. 2, pp. 225–228.) Theoretical investigation of the density distribution and the equivalent depth of penetration of a transient current, for the case of a plane TEM wave incident normally upon a plane conductor. Particular pulse waveforms are considered. See also 1900 of 1950.

537.52 **2068**

The Decay of the Space Charges in Intermittent Discharges in Neon and Argon.—D. Brini & P. Veronesi. (*Nuovo Cim.*, 1st Dec. 1953, Vol. 10, No. 12, pp. 1662–1672. In English.) The influence of the gas pressure and electrode separation on the decay of the space charges is investigated experimentally. The decay times for both neon and argon appear to be of the order of 10^{-3} sec, and are nearly proportional to the pressure over the range of measurement (about 1–40 Torr). Possible explanations of these values are discussed, and the various regions of the static characteristic are related to the functioning of counters and periodic discharges.

537.523 **2069**

The High-Pressure Glow Discharge in Air.—W. A. Gambling & H. Edels. (*Brit. J. appl. Phys.*, Jan. 1954, Vol. 5, No. 1, pp. 36–39.) Report of observations on the glow discharge in air at a pressure of about 760 mm Hg, between Cu and W electrodes; characteristics are given for discharge lengths of 0–8 mm and currents of 0·01–0·5 A.

537.525.5 : 621.396.822 **2070**

Spectrum Intensities and Radio Frequency Noise in a D.C. Hydrogen Arc.—S. E. Williams & V. Maslen. (*Nature, Lond.*, 20th Feb. 1954, Vol. 173, No. 4399, pp. 361–362.) R.f. noise generated by the arc was reduced by shunting the arc with a capacitor; this caused an incidental modification of the ultraviolet spectrum. The results suggest a connection between the noise intensity and the distribution of energy among the electrons.

537.533 : 546.74 **2071**

Investigation of the Electron Emission from Nickel.—G. V. Spivak & A. Gel'berg. (*C. R. Acad. Sci. U.R.S.S.*, 21st Jan. 1954, Vol. 94, No. 3, pp. 455–458. In Russian.) Experiments show that the work function of a single crystal of Ni, reduced in hydrogen, is higher above the Curie point than below it. This result is shown graphically. Field strengths of about 6×10^7 V/cm were used in measurements of electron emission from a point source. Photographs of the emission patterns are shown.

537.56 **2072**

A Note on the Formula for the Mobility of Electrons with Mean Free Path varying with Velocity.—P. M. Davidson. (*Proc. phys. Soc.*, 1st Feb. 1954, Vol. 67, No. 410B, pp. 159–161. Correction, *ibid.*, 1st March 1954, Vol. 67, No. 411B, p. 279.) A correct generalized formula is derived for the electronic drift velocity in an ionized gas, taking the Townsend-Ramsauer effect into account.

537.582 **2073**

Theory of the Work Function of Metals.—W. Oldekop & F. Sauter. (*Z. Phys.*, 25th Jan. 1954, Vol. 136, No. 5, pp. 534–546.) The polarizing action of individual electrons on the distribution of the remaining electrons in the conduction band is investigated by means of extended Thomas-Fermi statistics and the effect on the magnitude of the work function is calculated. In alkali metals the work function is determined largely by this polarization effect (image force) and only slightly by the electrostatic double-layer at the metal boundary.

538.248 **2074**

Fluctuation Magnetic After-Effect.—J. C. Barbier. (*Ann. Phys., Paris*, Jan./Feb. 1954, Vol. 9, pp. 84–140.) Thesis, based on Néel's theory, on the irreversible after-effect in ferromagnetic materials which is identified with the residual loss. Earlier reports of the work were noted in 2237 of 1952 and 1661 of 1950, in which it should have been stated that the square root of the remanent magnetization is proportional to the logarithm of time elapsed from the suppression of the field and to the logarithm of the duration of application.

538.3 **2075**

Self-Consistent Electrodynamics.—O. Buneman. (*Proc. Camb. phil. Soc.*, Jan. 1954, Vol. 50, Part 1, pp. 77–97.) "The idea of direct action between streams is applied to a continuous charged fluid and combined with the new formulation of the electrodynamical laws of motion in terms of conservation of circulation. A simple and rigorous integrated formulation is thus obtained from the Maxwell-Lorentz differential equations, applicable to co-existing positive and negative fluids, as well as vacuum. Exact solutions are obtained, among them one which represents self-consistent, self-maintained flow in a hollow tubular region of infinite axial extent. It is hoped this tube might be bent into a torus and that an electron model will result from merely quantizing the one or two vortices around which this flow-pattern circulates."

538.52 : 537.311.5 : 621.396.677.8 **2076**

On the Current induced in a Conducting Ribbon by a Current Filament Parallel to it.—E. B. Moullin. (*Proc. Instn elect. Engrs*, Part IV, Feb. 1954, Vol. 101, No. 6, pp. 7–17.) Full paper. See 704 of March.

538.56 : 535.422 **2077**

On the Complete Theory of Diffraction of Electric Waves by a Perfect Conducting Wedge.—Y. Nomura. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, Dec. 1952, Vol. 4, No. 1, pp. 29–50.) Continuation of work abstracted in 374 of 1952. The analysis is revised and completed, and errata are corrected.

538.566 : 535.42 **2078**

Diffraction of Electromagnetic Waves by an Aperture in a Large Screen.—J. H. Crysdale. (*J. appl. Phys.*, Feb. 1954, Vol. 25, No. 2, pp. 269–270.) Bekefi's approximate formula (709 of March) is derived simply by another method.

538.569.4.029.65 : 535.33 **2079**

One-to-Two Millimeter Wave Spectroscopy: Part 4 — Experimental Methods and Results for OCS, CH_3F, and H_2O.—W. C. King & W. Gordy. (*Phys. Rev.*, 1st Feb. 1954, Vol. 93, No. 3, pp. 407–412.) Continuation of work reported previously (2623 of 1953). Multiplier and detector performance were greatly improved by using crystals small compared to the wavelength to be detected. A new tuning technique based on known absorption lines was developed. Measurements made included that of a new water-vapour line at 183·31130 ± 0·00030 kMc/s.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.2/.8 : 621.396.822] : 621.396.621 **2080**

A D.C. Comparison Radiometer.—Selove. (See 2205.)

523.746 **2081**

Revised Data for the Mean Sunspot Curve.—W. Gleissberg. (*Naturwissenschaften*, Feb. 1954, Vol. 41, No. 4, p. 82.) When the data for the present nearly concluded 11-year cycle are included with those for the seventeen preceding cycles, the mean curve exhibits a slightly steeper rise and a slightly shallower fall, thus increasing its asymmetry.

523.746 : 550.386 **2082**

Controls of Geomagnetic Activity by Sunspots.—U. Becker & J. F. Denisse. (*J. atmos. terr. Phys.*, March 1954, Vol. 5, No. 1, pp. 70–72.) Becker (*Z. Astrophys.*,

1953, Vol. 32, p. 195) showed that a decrease of magnetic activity occurs when two sunspots or groups of sunspots are symmetrically located on the solar disk with respect to the solar equator. On the basis of this work and that of Denisse (2642 of 1953), it should be possible to forecast each year, on an average, about 80 perturbed and 75 quiet days.

523.854 : 621.396.822 **2083**

Identification of the Most Powerful Discrete Sources of Radio Emission of the Galaxy with the Residua of Supernovae Exploded in the Last 2000 Years.—I. S. Shklovski. (*C. R. Acad. Sci. U.R.S.S.*, 21st Jan. 1954, Vol. 94, No. 3, pp. 417–420. In Russian.)

550.38 : 551.510.535 : 621.396.11 **2084**

Experimental Determination of the Total Intensity of the Terrestrial Magnetic Field in the Lower Region of the Upper Atmosphere (E Layer).—M. Cutolo. (*Nuovo Cim.*, 1st July 1953, Vol. 10, No. 7, pp. 915–925.) Fuller account of work described previously (720 of March).

551.510.535 **2085**

Plasma Theory of the Ionosphere.—I. Lucas & A. Schlüter. (*Arch. elekt. Übertragung*, Jan. 1954, Vol. 8, No. 1, pp. 27–30.) The basic equations for the dynamic and electrical behaviour of the ionosphere are derived from the theory of a neutral plasma, and are used to investigate the problems of diffusion of the plasma at layer boundaries, e.m. damping of air movements and tidal oscillations of the ionosphere.

551.510.535 **2086**

Electron Density in the Upper Atmosphere and Interpretation of the *h'f* Curves of Ionosphere Virtual Height: Part 2.—F. Mariani. (*Ann. Geofis.*, Oct. 1953, Vol. 6, No. 4, pp. 533–553.) A calculation is made of the optical path of a wave reflected by a Chapman layer with a semithickness 2·5 H (where H is the scale height). Comparison of the results with those obtained previously (3598 of 1953) indicates that the lower half of such a layer is closely approximated by a parabolic layer of semithickness 1·5 H. The electron density distribution is investigated for regions of superposition of the F_1 and true F_2 layers, taking recombination into account. The linear superposition formula used previously is found to be inadequate and is replaced by the formula $N = (N_1^2 + N_2^2)^{\frac{1}{2}}$, where N_1 and N_2 are the independent densities of the F_1 and the true F_2 layers.

551.510.535 **2087**

A Tentative Model of the Equilibrium Height Distribution of Nitric Oxide in the High Atmosphere and the Resulting D Layer.—A. P. Mitra. (*J. atmos. terr. Phys.*, March 1954, Vol. 5, No. 1, pp. 28–43.) Two possible processes for the production of NO are considered, (*a*) three-body recombination with O, and (*b*) photodissociation of N_2O into N and NO. The distribution of known constituents of the atmosphere in the 50–100-km range is discussed, and the NO height distribution derived for the two possible production processes. D-layer ionization characteristics are satisfactorily explained, assuming photoionization of NO at $\lambda < 1\,300$ Å, and the electron distribution is derived, both for the case of photochemical equilibrium of NO and for a nonequilibrium distribution under the condition of complete mixing.

551.510.535 **2088**

The Determination of the Electron Density Distribution of an Ionosphere Layer in the Presence of an External Magnetic Field.—J. M. Kelso. (*J. atmos. terr. Phys.*, March 1954, Vol. 5, No. 1, pp. 11–27.) "The electron density distribution is determined by finding the actual heights at which waves of various frequencies are reflected. These true heights are obtained from experimental *h'-f* curves by obtaining the exact solution, as a convergent series of integrals, of the integral equation giving the group height as a function of frequency. The errors arising in the numerical work are shown by applying the procedure to *h'-f* curves obtained theoretically from layers of known shape, and such errors are seen to be small compared with those made through use of other procedures."

551.510.535 **2089**

Regularities in the F Region of the Ionosphere.—B. Chatterjee. (*Nature, Lond.*, 6th Feb. 1954, Vol. 173, No. 4397, pp. 263–264.) Justification of the assumptions made in 407 of February is presented.

551.510.535 : 551.543 **2090**

Correlation between Variations of Surface Pressure and Ionospheric Parameters.—M. R. Kundu. (*Indian J. Phys.*, May 1953, Vol. 27, No. 5, pp. 235–243.) A statistical analysis was made of meteorological and ionospheric data obtained at Calcutta during the period 1948–1951. Correlation between variations of ionosphere parameters and of surface pressure was found at least for some months of the year. The results are in agreement with those obtained in Australia by Martyn & Pulley (*Proc. roy. Soc. A*, 1936, Vol. 154, p. 455). Previously proposed tentative explanations based on variations of ozone content or the effects of circulation in the troposphere are examined; further data are required in order to assess their correctness.

551.510.535 : 551.55 **2091**

Recent Advances in the Study of Ionospheric Winds.—L. A. Manning. (*Bull. Amer. met. Soc.*, Nov. 1953, Vol. 34, No. 9, pp. 401–405.) The radio-fading method developed by Mitra (96 of 1950) and the meteor-trail-echo method developed by Manning et al. (3052 of 1950) for investigating ionospheric winds are briefly reviewed, and results so far obtained are discussed.

551.510.535 : 621.396.11 **2092**

The Effect of Sunrise on the Reflection Height of Low Frequency Waves.—S. B. Brown & W. Petrie. (*Canad. J. Phys.*, Jan. 1954, Vol. 32, No. 1, pp. 90–98.) The observed sudden changes of phase and amplitude of 16-kc/s waves transmitted over distances of 540 km are discussed in relation to the geometry of the system at the change-over from night-time to daytime reflection height (95 km and 70 km respectively). The effect cannot be due to photoionization of atmospheric molecules, but may be due to the removal of electrons from negative oxygen ions by visible and near-infrared radiation; calculations are presented giving support to this view. The rate of fall of the reflection height is discussed.

551.594.13 : 551.508.11 **2093**

Measurement of the Electrical Conductivity in the Upper Air by Radiosonde.—S. P. Venkiteshwaran, B. K. Gupta & B. B. Huddar. (*Proc. Indian Acad. Sci. A*, Aug. 1953, Vol. 38, No. 2, pp. 109–115.) Description of a measurement technique using the Gerdien conductivity apparatus in conjunction with a valve electrometer and an a.f.-modulated American type radiosonde.

551.594.21 **2094**

Generation of Electricity in Thunderstorms.—B. J. Mason. (*Elect. Times*, 4th Feb. 1954, Vol. 125, No. 3248, pp. 159–163.) A general account of the origin and nature of lightning.

551.594.6 : 538.566 **2095**

The Higher-Order Modes in the Propagation of Long Electric Waves in the Earth-Air-Ionosphere System and Two Applications (Horizontal and Vertical Dipole).—Schumann. (See 2195.)

LOCATION AND AIDS TO NAVIGATION

621.396.93 : 621.396.663 **2096**

Investigation of the Interference Field of Electromagnetic Waves with a C.R. Direction Finder.—J. Pietzner. (*Fernmeldetech. Z.*, Feb. 1954, Vol. 7, No. 2, pp. 80–84.) Description of a system for determining the directions of two interfering transmitters operating on the same frequency. The Adcock- and vertical-aerial systems are used in conjunction with a goniometer so that the signals applied to the Y and X plates of the c.r.o. are the signals received effectively by aerials with cardioid and figure-of-eight polar diagrams respectively. The two goniometer settings at which the c.r.o. trace reduces to a straight line are ϕ_1 and ϕ_2–ϕ_1–180°, respectively, where ϕ_1 and ϕ_2 are the bearings for the two transmitters.

621.396.962.3 : 621.396.621 **2097**

Use of Superregenerative Receivers as Intermediate-Frequency Amplifiers for Pulsed Radar Reception.—S. Marmor. (*Onde élect.*, Jan. 1954, Vol. 34, No. 322, pp. 73–79.) Operating principles of a superregenerative receiver for pulse reception (481 of 1952) are outlined. Its performance at a wavelength of 3·2 cm is compared with that of a conventional superheterodyne receiver. Typical p.p.i. and Type-A displays in the two cases are compared.

621.396.962.3 : 621.396.822 **2098**

The Minimum Usable Signal in Radar Reception and its Improvement by Certain Correlation Techniques.—L. Gérardin. (*Onde élect.*, Jan. 1954, Vol. 34, No. 322, pp. 67–72.) The definition of minimum usable signal in terms of signal/noise ratio and probability of detection is discussed. Experimental results obtained at a wavelength of 10 cm, using a 12-in. c.r. tube with p.p.i. display, are in agreement with calculations reported by Ross (1653 of 1951). For a p.p.i. display, under normal conditions the minimum usable signal is the tangential signal, viz. a signal 8 db above r.m.s. noise power. Principles of design of linear and nonlinear filters effectively increasing signal/noise ratio are outlined.

621.396.962.38 **2099**

Secondary Surveillance Radar.—D. A. Levell. (*Wireless World*, May 1954, Vol. 60, No. 5, pp. 227–230.) An experimental system tried at London Airport uses an interrogation frequency of 1·215 kMc/s and a response frequency of 1·375 kMc/s. The interrogating signal comprises three 1-μs pulses, (*a*) a reference pulse actuating gating circuits in the airborne transponder, (*b*) a control pulse, and (*c*) the interrogator pulse proper. The separation between the leading edges of (*a*) and (*b*) is 5 μs and that between the leading edges of (*a*) and (*c*) is 16 μs. (*a*) and (*c*) are produced by the same oscillator and radiated from the same directional aerial, (*b*) is produced separately and radiated omnidirectionally. When the received control pulse exceeds the following interrogator pulse by more than 3 db the interrogator pulse is prevented from passing through the gate. Side-lobe responses are thus prevented.

621.396.963.325 **2100**

Circular Radar cuts Rain Clutter.—W. D. White. (*Electronics*, March 1954, Vol. 27, No. 3, pp. 158–180.) A 1·3-kMc/s radar unit was modified for use with circularly polarized radiation by covering the dish-shaped reflector with wire mesh. Improvements in target/precipitation ratio varying from 8 to 25 db were obtained. The adverse effect of ground reflections is noted. Details are given of the statistical method used in measurements on aircraft targets.

621.396.969.33 + 621.396.969.36 **2101**

A Survey of Five Years' Progress in Marine Radar.—F. J. Wylie. (*J. Inst. Nav.*, Jan. 1954, Vol. 7, No. 1, pp. 59–77.)

MATERIALS AND SUBSIDIARY TECHNIQUES

531.788.7 **2102**

Ultra-High Vacuum: Part 2 — Limiting Factors on the Attainment of Very Low Pressures.—D. Alpert & R. S. Buritz. (*J. appl. Phys.*, Feb. 1954, Vol. 25, No. 2, pp. 202–209.) Continuation of work reported in 3603 of 1953 (Alpert). Calibration of the Bayard-Alpert ionization gauge shows that its characteristic is linear over most of its useful range, 5×10^{-10}–10^{-3} mm Hg. The achievement of very low pressures in glass systems is limited ultimately by diffusion of atmospheric He through the walls. A simplified omegatron [*Phys. Rev.*, 1st June 1951, Vol. 82, No. 5, pp. 697–702 (Sommer et al.)] has been developed for the measurement of partial pressures in a highly evacuated system.

535.215 : 546.817.221 **2103**

Bulk Photoconductivity in Lead Sulfide.—D. E. Soule & R. J. Cashman. (*Phys. Rev.*, 1st Feb. 1954, Vol. 93, No. 3, pp. 635–636.) Preliminary results of experiments at 77°K on three cleaved synthetic PbS crystals are reported. The crystal surface was scanned by a light spot and the resulting photocurrent measured. Current maxima were found at points on the crystal at which internal potential barriers were known to exist.

535.215.3 : 538.639 : 546.289 **2104**

Contribution to the Study of the Photomagnetoelectric Effect in Germanium.—H. Bulliard. (*Ann. Phys., Paris*, Jan./Feb. 1954, Vol. 9, pp. 52–83.) Detailed report of a theoretical and experimental investigation. See also 2015 and 2016 of 1953 (Aigrain & Bulliard). Values for the coefficient of volume recombination and the surface recombination velocity are calculated.

535.3 : [546.817.221 + 546.817.231 + 546.817.241 **2105**

Further Measurements on the Optical Properties of Lead Sulphide, Selenide and Telluride.—D. G. Avery. (*Proc. phys. Soc.*, 1st Jan. 1954, Vol. 67, No. 409B, pp. 2–8.) Continuation of earlier work (2018 of 1953). Measurements have been made at wavelengths up to 6 μ, using reflection techniques. Temperature effects on PbS and the effects of baking in an O_2 atmosphere are discussed.

535.34 : [537.311.31 + 537.311.33 **2106**

On the Theory of Optical Absorption in Metals and Semiconductors.—R. Wolfe. (*Proc. phys. Soc.*, 1st Jan. 1954, Vol. 67, No. 409A, pp. 74–84.) A quantum-mechanics method is described for calculating the effect on the optical absorption of any of the factors responsible for electrical resistance. The electrons scattered by imperfections in the crystal lattice are considered to absorb light by a photoelectric process. The results calculated, using a first-order approximation, for the case where the conduction electrons are scattered by dissolved impurities are similar to those obtained using semi-classical theory in which the current set up by the light is assumed to be damped by the impurities. For semiconductors, the new method gives much lower absorption values than the semiclassical method. The use of exact wave functions for the very slow electrons in semiconductors would give greatly increased absorption coefficients.

535.37 **2107**

Emission Spectra of Multiply Activated Electroluminescent Materials.—G. Destriau. (*J. Phys. Radium*, Jan. 1954, Vol. 15, No. 1, pp. 13–15.) The spectra are

composed of bands associated respectively with the different activators. The electroluminescence spectra may be very different from the fluorescence spectra, and are greatly influenced by the frequency and intensity of the exciting field.

535.37 **2108**

Periodic Variations of Brightness in Electroluminescence and in Luminous Surface Effects.—G. Curie & D. Curie. (*J. Phys. Radium*, Jan. 1954, Vol. 15, No. 1, pp. 61–62.) The observed phase shift of electroluminescence brightness variations with respect to the exciting field is interpreted as supporting the view that electroluminescence is essentially a volume rather than a surface effect.

535.37 **2109**

Temperature Dependence of the Electroluminescence of ZnS and ZnO Phosphors.—H. Gobrecht, D. Hahn & H. E. Gumlich. (*Z. Phys.*, 25th Jan. 1954, Vol. 136, No. 5, pp. 623–630.) Further investigations (see 2110 below) revealed an electrothermoluminescence effect in variously activated ZnS and ZnO phosphors, the luminescence/temperature curve exhibiting maxima at a number of points when the phosphor is slowly heated from $-$ 100°C to room temperature. The positions of the maxima are independent of field strength and frequency. On cooling, luminescence increases monotonically over a large part or the whole of the temperature range.

535.37 : 537.228 **2110**

Electroluminescence of Various Phosphors and its Dependence on the Strength and Frequency of the Alternating Electric Field.—H. Gobrecht, D. Hahn & H. E. Gumlich. (*Z. Phys.*, 25th Jan. 1954, Vol. 136, No. 5, pp. 612–622.) Electroluminescence was produced in phosphors at $-$ 100°C by using alternating fields of strengths between 10^4 and 10^5 V/cm and frequencies between 100 c/s and 10 kc/s. Results show that Zn and Cd sulphides and ZnO are excited more easily than other materials, that oxidizing pre-treatment of the sulphides reduces their electroluminescence field-strength threshold, and that luminescence can be excited in other materials by a glow-discharge caused by the field. Several criteria for distinguishing true electroluminescence from this latter case are given. The intensity of electroluminescence increases with field strength and frequency. Possible causes of these phenomena are discussed.

535.37 : 537.533.8 **2111**

The Effect of Organic Vapor on the Secondary Emission of Phosphors.—P. H. Dowling & J. R. Sewell. (*J. appl. Phys.*, Feb. 1954, Vol. 25, No. 2, pp. 228–230.) Experiments show that surface contamination causes a rapid reduction of the secondary emission ratio. If the bombardment voltage is sufficiently high this results in a progressive decrease in the surface potential and a corresponding decrease in apparent fluorescence efficiency. The relation between this effect and true 'phosphor burn' is discussed. Organic-vapour contamination may accelerate the development of 'cross burn' in c.r. tubes.

535.376 **2112**

Characteristics of Radioluminescence in Crystals.—G. T. Wright & G. F. J. Garlick. (*Brit. J. appl. Phys.*, Jan. 1954, Vol. 5, No. 1, pp. 13–18.) Report of an experimental investigation of the variation of light output with particle energy for single crystals of organic and inorganic phosphors excited by α particles.

535.376 **2113**

A Luminescent Screen for Use with Very-Low-Velocity Electrons.—S. F. Kaisel & C. B. Clark. (*J. opt. Soc. Amer.*, Feb. 1954, Vol. 44, No. 2, pp. 134–135.) Screens responding to excitation by electrons with energy as low as 3 eV are prepared by settling a phosphor designated as 'hex ZnO: (Zn)' on to a glass plate previously coated with a transparent conducting film.

535.376 **2114**

Excitation of Zinc Oxide Phosphors by Low-Energy Electrons.—R. E. Shrader & S. F. Kaisel. (*J. opt. Soc. Amer.*, Feb. 1954, Vol. 44, No. 2, pp. 135–139.) An experimental investigation was made for cases where the energy of the exciting electrons was not greater than that of the observed photons. The results suggest that any electron accepted by the crystal lattice is capable of producing luminescence in ZnO phosphors, no matter how low the bombarding voltage.

537.227 **2115**

Phase Transitions in Ferroelectric $KNbO_3$.—G. Shirane, H. Danner, A. Pavlovic & R. Pepinsky. (*Phys. Rev.*, 15th Feb. 1954, Vol. 93, No. 4, pp. 672–673.) A third phase transition has been observed at $-$ 10°C on heating and $-$ 55°C on cooling, a change from orthorhombic to rhombohedral structure being accompanied by an abrupt change of dielectric constant.

537.227 : 546.431.824-31 **2116**

Effect of a Two-Dimensional Pressure on the Curie Point of Barium Titanate.—P. W. Forsbergh, Jr. (*Phys. Rev.*, 15th Feb. 1954, Vol. 93, No. 4, pp. 686–692.) A disk-shaped single-crystal specimen of $BaTiO_3$ was subjected to pressure on its edges and not on its faces. The transition temperature increased with the two-dimensional pressure. This result is discussed in relation to previous experiments in which hydrostatic pressure was applied.

537.311.31 : 548.0 **2117**

Lattice Defects and the Electrical Resistivity of Metals.—T. Broom. (*Advances Phys.*, Jan. 1954, Vol. 3, No. 9, pp. 26–83.) Calculations of the effect of lattice defects on resistivity are summarized and the results are discussed in relation to observations made by quenching, irradiation and deformation experiments.

537.311.31 : 669-124.2 **2118**

The Effect of Cold-Work on the Electrical Resistivity of Alloys and the Law of Recovery.—J. O. Linde. (*Appl. sci. Res.*, 1954, Vol. B4, Nos. 1/2, pp. 73–86.) Measurements are reported on alloys with Cu, Ag or Au as matrix component. The resistivity changes resulting from cold working differ greatly for the various alloys. Au-Cr and Au-Fe alloys exhibit a decrease of resistivity. Recovery is studied for various annealing temperatures. A law is established expressing the resistivity change as a function of temperature and time. The results are discussed in relation to theory.

537.311.33 **2119**

Theory of the Differential Thermoelectric Power of Semiconductors.—G. Lautz. (*Z. Naturf.*, June 1953, Vol. 8a, No. 6, pp. 361–371.) Two formulae are derived for determining the Fermi level, the one applicable at the low temperatures associated with impurity semiconduction and the other applicable at the medium and high temperatures associated with the transition from impurity to intrinsic conditions and with purely intrinsic semiconduction. Expressions for the thermoelectric power are derived which are valid over a wide temperature range. These can be used to determine activation energy, width of energy gap and apparent mass of charge carriers. The limits of validity of the approximate formulae are demonstrated by comparison with exact solutions for two examples. Some experimental results

on the temperature dependence of the thermoelectric power are discussed, showing qualitative agreement with the theoretical results.

537.311.33 **2120**

On the Existence of Hertzian Absorption Bands in Monatomic Semiconductors (Boron, Selenium).—J. Meinnel. (*J. Phys. Radium*, Feb. 1954, Vol. 15, No. 2, pp. 124–125.) Preliminary results of measurements at temperatures in the range 88°–300°K and at frequencies from 100 c/s to 400 kc/s show that one or more absorption bands exist.

537.311.33 : 546.24 : 535.323 **2121**

Infrared Index of Refraction of Tellurium Crystals.—P. A. Hartig & J. J. Loferski. (*J. opt. Soc. Amer.*, Jan. 1954, Vol. 44, No. 1, pp. 17–18.)

537.311.33 : 546.24-1 : 535.343 **2122**

Infrared Optical Properties of Single Crystals of Tellurium.—J. J. Loferski. (*Phys. Rev.*, 15th Feb. 1954, Vol. 93, No. 4, pp. 707–716.) The absorption and photoconductivity were investigated experimentally, the effects of temperature variation, crystal anisotropy and Se additions being studied. The variation of energy gap with temperature is -2×10^{-5} eV/°C. The photoconductivity is barely detectable at room temperature but is considerably enhanced at 90°K. Results obtained with two SeTe alloys indicate that the reduction of the lattice parameter is accompanied by an increase of the energy gap.

537.311.33 : 546.289 **2123**

Orientation Relationships in Cast Germanium.—W. C. Ellis & J. Fageant. (*J. Metals, N.Y.*, Feb. 1954, Vol. 6, No. 2, pp. 291–294.)

537.311.33 : 546.289 **2124**

Dislocations in Plastically Deformed Germanium.—G. L. Pearson, W. T. Read, Jr, & F. J. Morin. (*Phys. Rev.*, 15th Feb. 1954, Vol. 93, No. 4, pp. 666–667.) Hall-effect, conductivity and lifetime measurements were made on rods of *n*-type and of *p*-type Ge which had been bent while heated to about 650°C, and on control specimens. The results are consistent with the hypothesis that edge dislocations are associated with acceptor levels in the middle or upper half of the energy gap.

537.311.33 : 546.289 **2125**

Redistribution of Solutes by Formation and Solidification of a Molten Zone.—W. G. Pfann. (*J. Metals, N.Y.*, Feb. 1954, Vol. 6, No. 2, pp. 294–297.) Description of the production of step or graded *p-n* junctions in semiconductors by melting and re-solidifying a zone of a homogeneous ingot containing suitable concentrations of a donor and an acceptor in solid solution.

537.311.33 : 546.289 **2126**

Some Electrical Properties of Germanium Crystals containing Compensated Impurities.—V. Ozarow. (*Phys. Rev.*, 1st Feb. 1954, Vol. 93, No. 3, pp. 371–372.) Three compensated *n*-type Ge crystals containing both radioantimony and radioindium in varying amounts, and one uncompensated crystal doped with Sb only were prepared. Measurements of Hall constant and resistivity were made in the temperature range 78°–393°K. Marked differences in the characteristics of compensated and uncompensated crystals of comparable resistivities were noted.

537.311.33 : 546.289 **2127**

Electrical Properties of N-Type Germanium.—P. P. Debye & E. M. Conwell. (*Phys. Rev.*, 15th Feb. 1954, Vol. 93, No. 4, pp. 693–706.) Measurements of the conductivity and Hall effect over the temperature range 11°–300°K were made on specimens with various controlled amounts of added arsenic, the room-temperature resistivities ranging from 43 to 0·005Ω.cm. The results are used as the basis of a comprehensive review of semiconductor theory. The evidence supports the view that the constant-energy surfaces are not spherical, though results based on this simplifying assumption agree in many respects with the experimental results.

537.311.33 : 546.289 **2128**

Self-Diffusion in Germanium.—H. Letaw, Jr, L. M. Slifkin & W. M. Portnoy. (*Phys. Rev.*, 15th Feb. 1954, Vol. 93, No. 4, pp. 892–893.) Diffusion in thin slabs of Ge with a plating of Ge^{71} was determined by measuring the concentration of Ge^{71} in cuts of known mass and thickness. The results are discussed in relation to the vacancy-motion theory of diffusion.

537.311.33 : 546.289 **2129**

Measurement of Minority Carrier Lifetime and Contact Injection Ratio on Transistor Materials.—A. Many. (*Proc. phys. Soc.*, 1st Jan. 1954, Vol. 67, No. 409B, pp. 9–17.) Lifetime is determined by observing the decay of resistance of a filament of the material during an injecting pulse. By using a bridge circuit incorporating a *RC* network electrically analogous to the filament, the lifetime can be read directly on a calibrated dial. The measurement range extends down to 1μs, with an accuracy usually to within about 5%. Measurements on *n*-type Ge with soldered contacts are reported; the injection ratio is proportional to the current through the contact.

537.311.33 : 546.289 **2130**

The Temperature Dependence of the Drift Mobility of Injected Holes in Germanium.—R. Lawrance. (*Proc. phys. Soc.*, 1st Jan. 1954, Vol. 67, No. 409B, pp. 18–27.) Report of an experimental investigation of the effect of trapping in *n*-type Ge, and of the nature of the traps. The results have been reported previously (2332 of 1953).

537.311.33 : 546.289 : 535.323 **2131**

The Index of Refraction of Germanium measured by an Interference Method.—D. H. Rank, H. E. Bennett & D. C. Cronemeyer. (*J. opt. Soc. Amer.*, Jan. 1954, Vol. 44, No. 1, pp. 13–16.) Measurements in the wavelength range 2·0–2·4 μ are reported.

537.311.33 : 546.289 : 537.533.8 **2132**

Secondary Electron Emission from Germanium.—J. R. Johnson & K. G. McKay. (*Phys. Rev.*, 15th Feb. 1954, Vol. 93, No. 4, pp. 668–672.) Measurements were made on single crystals with *p-n* junctions. The secondary-emission yield δ exhibited a maximum value of about 1·15 at room temperature at a primary voltage of about 500 V. δ has a small negative temperature coefficient but is independent of donor or acceptor concentrations up to 10^{19}/cm³. No effects due to space-charge fields under the surface were observed in the case of Ge. The secondary-emission process in semiconductors generally is compared with that in metals and insulators.

537.311.33 : 546.682.86 **2133**

Radiation Effects in Indium Antimonide.—J. W. Cleland & J. H. Crawford, Jr. (*Phys. Rev.*, 15th Feb. 1954, Vol. 93, No. 4, pp. 894–895.) Polycrystalline specimens of both *n*-type and *p*-type InSb were subjected to neutron irradiation. The results of conductivity and Hall-coefficient measurements indicate that (*a*) donor impurities are introduced by transmutations in the expected manner, and (*b*) lattice defects produced by fast neutrons act as electron traps in *n*-type material.

The evidence is insufficient to indicate whether these defects behave predominantly as acceptors or hole traps in *p*-type material.

537.311.33 : 546.682.86 **2134**

Anomalous Optical Absorption Limit in InSb.—E. Burstein. (*Phys. Rev.*, 1st Feb. 1954, Vol. 93, No. 3, pp. 632–633.) Experimental results in agreement with those of Tanenbaum & Briggs (1098 of April) were obtained. An alternative theoretical explanation is offered, based on the very small effective mass of the electrons in InSb. This is associated with small effective density of states and with a small degeneracy concentration. InSb therefore becomes degenerate at relatively low electron densities.

537.311.33 : 546.811-17 : 538.632 **2135**

Electronic Conduction in Grey Tin.—J. T. Kendall. (*Phil. Mag.*, Feb. 1954, Vol. 45, No. 361, pp. 141–157.) The conductivity and Hall constant of grey tin containing antimony and/or gallium were measured over the temperature range 77°–286°K, and the number of charge carriers and their mobility were calculated from the results. A comparison is made with the corresponding properties of Si and Ge. Results are tabulated and shown graphically.

537.311.33 : 546.817.221 **2136**

Antimony Content and Semiconductor Properties of Synthetic Lead Sulphide Photoconductive Elements.—H. G. Smolczyk. (*Naturwissenschaften*, Feb. 1954, Vol. 41, No. 4, p. 84.) A preliminary report of experimental work. Measurements were made of the internal photoelectric effect and of the thermoelectric effect for specimens containing differents amounts of Sb and prepared under controlled pressure of sulphur vapour. The possibility of producing PbS *p-n* junctions is indicated.

537.311.33 : 548.0 : 546.817.221 **2137**

A Variation Principle for Electronic Wave Functions in Crystals.—D. P. Jenkins & L. Pincherle. (*Phil. Mag.*, Jan. 1954, Vol. 45, No. 360, pp. 93–99.) A variation principle giving the energy levels of electrons in polyatomic lattices is presented. The method is used to redetermine some of the energy levels of PbS; the results are in agreement with those obtained by other methods [2037 of 1953 (Bell et al.)].

537.311.33 : 548.55 **2138**

Preparation of Single Crystals of Semiconductor Compounds of Type A^{III} B^{V}.—R. Gremmelmaier & O. Madelung. (*Z. Naturf.*, May 1953, Vol. 8a, No. 5, pp. 333, 304A.) A method of pulling from the melt is used similar to that described by Teal et al. (1682 of 1951). Photographs of a single-crystal specimen of InSb and a polycrystalline specimen of AlSb produced by the method are shown.

537.311.33 : 621.396.822 **2139**

Some Notes on Gisolf's Theory of Electron Fluctuation Phenomena in Semiconductors.—K. W. Böer. (*Ann. Phys., Lpz.*, 5th Jan. 1954, Vol. 14, Nos. 1/2, pp. 87–96.) Gisolf's formulae (667 of 1950) are evaluated by introducing a statistical distribution of lifetimes for the conduction electrons. The effect of field distortion in the barrier layer is taken into account. The magnitude of the effect is compared with that of the Nyquist noise.

538.22 **2140**

Effects of Band Shape on the Magnetic and Thermal Properties of Metals and Alloys.—E. W. Elcock, P. Rhodes & A. Teviotdale. (*Proc. roy. Soc. A*, 7th Jan. 1954, Vol. 221, No. 1144, pp. 53–77.)

538.221 **2141**

Notes on the Theory of the Magnetic Properties of Hard Materials.—L. Néel. (*Appl. sci. Res.*, 1954, Vol. B4, Nos. 1/2, pp. 13–24. In French.) The theory of magnetic hysteresis for single-domain small grains is considered. By taking into account (*a*) the dispersion of the values of the coercive force for the individual grains and (*b*) the interaction force between the grains and the dispersion of the values of this force, numerical results are obtained which agree well with experimental results for good permanent magnets.

538.221 : 532.111 **2142**

The Change of Ferromagnetic Curie Points with Hydrostatic Pressure.—L. Patrick. (*Phys. Rev.*, 1st Feb. 1954, Vol. 93, No. 3, pp. 384–392.) Consistent results for eight materials measured in a liquid compression system were obtained. Results for five other materials measured in a gas compression system were less satisfactory. Neither the Bozorth nor the Néel theoretical interaction curve agrees with the experimental observations; this may be due to neglect of the part played by conduction electrons in the interaction.

538.221 : 532.111 **2143**

The Influence of Pressure on the Curie Temperature of Iron and Nickel.—R. Smoluchowski. (*Phys. Rev.*, 1st Feb. 1954, Vol. 93, No. 3, pp. 392–393.) A comparison is made between Patrick's measurements (2142 above) and theory based on a Brillouin function.

538.221 : 621.318.124 + 621.318.134 **2144**

Magnetic Resonance Phenomena in Ferrites.—F. Brown & D. Park. (*Phys. Rev.*, 1st Feb. 1954, Vol. 93, No. 3, pp. 381–384.) The resonance frequencies in the microwave and infrared regions are calculated, taking into account the effects of anisotropy, external field and differences in magnetization and *g* values between the two sublattices. The relation between the anisotropy fields in the expressions derived and the measured equivalent anisotropy field is discussed. Theoretical and experimental results for single-crystal Ni ferrite are in good agreement. See also 1828 of June (Wangsness).

538.221 : 621.318.134 **2145**

Microwave Resonance Absorption in Nickel Ferrite-Aluminate.—T. R. McGuire. (*Phys. Rev.*, 15th Feb. 1954, Vol. 93, No. 4, pp. 682–686.) Results are reported of experiments on materials having the composition $NiOAl_tFe_{2-t}O_3$, with particular attention to the composition for which the value of t is 0·7, at which value the magnetic moment is zero.

538.221 : 621.318.134 **2146**

Ferrites for Microwave Circuits and Digital Computers.—E. Albers-Shoenberg. (*J. appl. Phys.*, Feb. 1954, Vol. 25, No. 2, pp. 152–154.) Properties of two classes of commercially available Mg-Mn ferrites are discussed. One class is characterized by low losses and a Faraday rotation effect at microwave frequencies; the other by high resistivity and a rectangular hysteresis loop useful in magnetic storage systems operating at high speed.

538.221 : 621.318.134 : 681.142 **2147**

Ferromagnetic Spinels with Rectangular Hysteresis Loops.—Hegyi. (See 2007.)

538.221 : 681.142 **2148**

Penetration of an Electromagnetic Wave into a Ferromagnetic Material.—Papoulis. (See 2006.)

548.0 : 546.39.185-841 : 539.374 **2149**

The Plastic Deformation of Ammonium Dihydrogen Phosphate.—P. L. Smith & E. I. Salkovitz. (*J. appl.*

Phys., Feb. 1954, Vol. 25, No. 2, pp. 237–239.) Plastic deformation was produced in ADP single crystals by loading specimens as a simple beam at about 100°C. This deformation does not appreciably alter the piezoelectric or elastic properties.

549.514.51 : 621.372.412.002.2 **2150**

V.H.F. Crystal Grinding.—E. A. Gerber. (*Electronics*, March 1954, Vol. 27, No. 3, pp. 161–163.) Round crystals for frequency control in the range 20–180 Mc/s are finished by fastening the blanks to a work-holder when about 0·7 mm thick and reducing them to the required thickness on optical lapping machines. Crystals with low series resistance are obtained. Unwanted modes of vibration are reduced.

621.315.61 **2151**

New Nonrigid Materials for the Functional Design of Electrical Insulating Systems.—A. E. Javitz. (*Elect. Mfg*, Sept. 1953, Vol. 52, No. 3, pp. 123–138.) A survey of the properties and performance of recently developed types of insulation in the form of film, tape, sheet and paper.

621.315.612.029.6 **2152**

Materials and Problems of High-Frequency Ceramics.—J. Kainz. (*Elektrotech. u. Maschinenb.*, 1st Nov. & 1st Dec. 1953, Vol. 70, Nos. 21 & 23, pp. 473–478 & 525–530.) A survey paper. Composition and properties of various ceramic insulating materials are tabulated and shown in graphs. Investigations of the colloid systems by means of the electron microscope are described.

621.315.616 **2153**

Conductivity induced in Insulating Materials by X-rays.—J. F. Fowler & F. T. Farmer. (*Nature, Lond.*, 13th Feb. 1954, Vol. 173, No. 4398, pp. 317–318.) Measurements on polythene and perspex are reported; the results are of interest in connection with the determination of the energy-level distribution of the material.

621.791.342.6 : 546.682 **2154**

A Technique of Soldering to Thin Metal Films.—R. B. Belser. (*Rev. sci. Instrum.*, Feb. 1954, Vol. 25, No. 2, pp. 180–183.) By using In and certain of its alloys as a solder, without a flux, adherence of thin metal films to glass or quartz substrates may be obtained without damage to the film. The technique has been successfully applied in the mechanical suspension of mirrors, for making electrical contact with thin metal films and for mounting piezoelectric crystals. Soldered connections have been made to films of 18 metals including Al, Ti and Zr.

MATHEMATICS

514.1 **2155**

Some Formulae of P. Stein and Others concerning Trigonometrical Sums.—N. B. Slater. (*Proc. Camb. phil. Soc.*, Jan. 1954, Vol. 50, Part 1, pp. 33–39.) Formulae relevant to problems of alternating currents in cables are discussed.

517.43 **2156**

Approximations in Operational Methods.—J. Brodin. (*Ann. Télécommun.*, Jan. 1954, Vol. 9, No. 1, pp. 1–8.)

517.5 **2157**

Recurrence Relations for Prolate Spheroidal Wave Functions.—I. Marx. (*J. Math. Phys.*, Jan. 1954, Vol. 32, No. 4, pp. 269–275.)

517.6 **2158**

An Approximate Method of Evaluating Integral Transforms.—A. H. Zemanian. (*J. appl. Phys.*, Feb. 1954, Vol. 25, No. 2, pp. 262–266.) The method developed is quite general and has been applied to Fourier, Laplace, Mellin and Hankel transforms. It may also be effective in evaluating numerically an integral with a highly oscillatory term in its integrand.

517.63 **2159**

On Inverting Laplace Transforms of the Form $h(s)/[p(s) + q(s)e^{-ts}]$.—T. E. Hull & W. A. Wolfe. (*Canad. J. Phys.*, Jan. 1954, Vol. 32, No. 1, pp. 72–80.)

517.9 **2160**

A Sufficient Condition for an Infinite Discrete Spectrum.—C. R. Putnam. (*Quart. appl. Math.*, Jan. 1954, Vol. 11, No. 4, pp. 484–487.) A study of the problem of obtaining a sufficient criterion in order that the equation $x'' + f(t)x = 0$ be oscillatory, for the particular case that $f(t)$ satisfies the limit relation $f(t) \to 0$ as $t \to \infty$.

517.9 **2161**

On the Gaps in the Spectrum of the Hill Equation.—C. R. Putnam. (*Quart. appl. Math.*, Jan. 1954, Vol. 11, No. 4, pp. 496–498.)

517.93 **2162**

Geometrical Integration of Nonlinear Second-Order Differential Equations with Second Member.—G. Cahen. (*Bull. Soc. franç. Élect.*, Jan. 1954, Vol. 4, No. 37, pp. 44–50.) A study is made of equations of the type

$$x + b(x)\dot{x} + r(x) = g(t),$$

and is extended to equations containing a further term $a(x)\dot{x}^2$ or $c(\dot{x})$.

517.942.82 : 621.3.015.3 **2163**

The Calculation of Transients in Dynamical Systems.—E. E. Ward. (*Proc. Camb. phil. Soc.*, Jan. 1954, Vol. 50, Part 1, pp. 49–59.) The calculation of transients by Tricomi's method, using Laguerre functions, is a practical alternative to the use of partial fractions. This is shown by considering numerical examples of Laplace transforms ranging from quadratic to sixth-power polynomials. The composition of the coefficients of the Laguerre series is analysed, and the conditions for rapid convergence are indicated.

519 : 53 **2164**

A Method of Solving Very Large Physical Systems in Easy Stages.—G. Kron. (*Proc. Inst. Radio Engrs*, April 1954, Vol. 42, No. 4, pp. 680–686.) By using the subdivision method of dealing with large systems (202 of January), the amount of calculation required to obtain the solution can be reduced approximately in the ratio $2/n^2$, where n is the number of subdivisions. The method is illustrated by solving the two-dimensional Maxwell field equations by subdividing their electric-circuit models.

MEASUREMENTS AND TEST GEAR

529.7 **2165**

The Determination of Time and Frequency.—H. M. Smith. (*Proc. Instn elect. Engrs*, Part II, Feb. 1954, Vol. 101, No. 79, pp. 64–65.) Discussion on 2223 of 1951.

621.317.3 : 621.314.632 : 546.289 **2166**

Use of the Germanium Rectifier for the Measurement of Current, Voltage and Power at High Frequency: Part 2 — Power Measurement.—J. Schiele. (*Arch. tech. Messen*, Jan. 1954, No. 216, pp. 21–22.) Two examples are illustrated. Part 1: 1498 of May.

621.317.3 : 621.372.56.029.63/.64 **2167**

Mismatch Errors in the Measurement of Ultrahigh-Frequency and Microwave Variable Attenuators.—R. W. Beatty. (*J. Res. nat. Bur. Stand.*, Jan. 1954, Vol. 52, No. 1, pp. 7–9.) Expressions for the mismatch error are derived by analysis and an example is given to show that the mismatch error in measuring the difference in attenuation between two attenuators is less than the sum of the mismatch errors obtained when measuring each attenuator individually.

621.317.3 : 621.396.722 **2168**

The B.B.C. Measurement and Technical Receiving Station at Tatsfield.—Griffiths. (See 2210.)

621.317.3.089.6 : 621.372.8 **2169**

The Calibration of the Slotted Section for Precision Microwave Measurements.—A. A. Oliner. (*Rev. sci. Instrum.*, Jan. 1954, Vol. 25, No. 1, pp. 13–20.) A calibration procedure is described in which compensation is made for the slight change in guide wavelength and characteristic impedance due to the slot, and for discontinuities at the end of the slot and at coupling elements, bead supports, etc. Practical instructions are given for constructing a calibration curve valid for purely reactive terminations, from which correction factors are derived for the position of the voltage node and the value of s.w.r. in dissipative structures.

621.317.326 : 621.314.626 **2170**

Pulse Measurement with Peak-Voltage Rectifier Circuit.—E. de Gruyter. (*Bull. schweiz. elektrotech. Ver.*, 6th Feb. 1954, Vol. 45, No. 3, pp. 61–70.) The suitability of direct-indicating peak voltmeters for measuring pulse trains is examined. For instruments using contact rectifiers, general error curves are given taking account of the instrument constants, the pulse width and the voltage reading, for different pulse shapes. Calibration of individual instruments is thus rendered unnecessary. An unknown pulse width can be determined from comparative measurements.

621.317.335.3.029.63 : 621.315.615 **2171**

Two New Methods of determining the Electrical Constants of Liquids in the Decimetre Waveband.—O. Huber. (*Z. angew. Phys.*, Jan. 1954, Vol. 6, No. 1, pp. 9–14.) The dielectric constant and the loss tangent are determined from measurements using a vertical coaxial line. In the first method, the voltage variations at a fixed probe are determined as a function of the depth of the liquid, the input termination being reflection-free. The second method depends on the change of resonance frequency of the short-circuited line when the liquid is introduced. See also 3046 of 1951.

621.317.336 : 621.372.8 **2172**

Measurement of Waveguide Impedance.—A. Cunliffe & D. P. Saville. (*Wireless Engr*, May 1954, Vol. 31, No. 5, pp. 115–118.) The two horizontal arms of a T junction are connected respectively to a waveguide section with a sliding short-circuiting termination and to the unknown impedance, while the vertical arm is connected to the source. Voltage is measured by means of a fixed probe in the arm connected to the unknown impedance, and the value of the latter is found by adjusting the short-circuit to produce resonance. Theory of the method is given. Results of experiments using a wavelength of 3·2 cm indicate that the accuracy compares favourably with that of the usual methods. The apparatus can be used over a wide frequency band.

621.317.34 : 621.315.212 **2173**

A Pulse Method for the Quantitative Determination of Nonuniformities in Wide-Band Cables.—L. Krügel. (*Fernmeldetech. Z.*, Jan. 1954, Vol. 7, No. 1, pp. 3–9.) A simple method suitable for investigating very small irregularities is described.

621.317.42 : 538.221 **2174**

The Effect of the Förster Probe on Measurements in the Vicinity of a Ferromagnetic Material.—F. Brandstaetter. (*Elektrotech. u. Maschinenb.*, 1st Nov. 1953, Vol. 70, No. 21, pp. 484–487.) An investigation of the influence of the macroscopic structure of the ferromagnetic material on the divergence between readings obtained with this instrument (1506 of May) and theoretically calculated values.

621.317.7 : 621.372.412 **2175**

Quartz Crystal Testing.—R. Rollin. (*Wireless World*, May 1954, Vol. 60, No. 5, pp. 220–223.) The principles described by Biggs & Wells (969 of 1946) are applied in equipment for evaluating the quality of crystals over the frequency range 50 kc/s–2 Mc/s. A two-valve oscillator with band-switching and input-capacitance switching is used in conjunction with a calibrated variable-impedance element which can be substituted for the crystal. The complete circuit is shown.

621.317.7.087 **2176**

Direct-Indicating Recording Instruments.—S. R. Gilford. (*Elect. Mfg.* Nov. & Dec. 1953, Vol. 52, Nos. 5 & 6, pp. 114–121 & 120–128.) A survey covering applications, functional requirements, design and operating principles.

621.317.723 **2177**

A Vibrating Needle Electrometer.—Y. L. Yousef & R. Kamel. (*J. sci. Instrum.*, Jan. 1954, Vol. 31, No. 1, pp. 13–15.) The e.s. force due to the charge under test is modulated so that instead of simply deflecting the suspended needle it produces a resonant vibration whose amplitude is proportional to the charge.

621.317.73/.74 : 621.315.212 **2178**

The Development of a Precision Termination for 0·375-inch Polythene-Disc-Insulated Coaxial Cable.—R. J. Cheetham, E. L. Mather & W. W. H. Clarke. (*Proc. Instn elect. Engrs*, Part IV, Feb. 1954, Vol. 101, No. 6, pp. 135–145.) The adjustment facilities necessary in a precision termination are determined from theoretical considerations and test requirements. Details are given of the development of a circuit suitable for use in pulse testing and in the determination of end impedances to within about 0·05Ω. In bridge testing, similar accuracies in both real and imaginary parts may be obtained between 50 kc/s and 8 Mc/s.

621.317.755 **2179**

Gated Time Markers for C.R.O. Display.—P. Steinberg. (*Electronics*, March 1954, Vol. 27, No. 3, pp. 150–151.) The waveform under examination and a series of marker dots are presented in alternate horizontal sweeps of the c.r.o.; the position and brightness of the two traces can thus be adjusted separately. A brief description is given of the circuit. Reading accuracy is increased by providing a vernier scale of marker dots.

621.317.755 : 621.314.7.012.6 **2180**

Characteristic-Curve Tracer for Transistors.—H. Lennartz.)*Funk u. Ton*, Jan. 1954, Vol. 8, No. 1, pp. 25–29.) Description of equipment used in conjunction with a c.r.o.

621.317.755 : 621.385.832 **2181**

An Interesting Four-Beam Cathode-Ray Tube.—Wendling. (See 2267.)

621.317.791 2182

Universal Meter for Measuring Voltages at High Impedances, Micromicroamperes, and Insulation Resistance.—W. R. Clark, R. E. Watson & G. C. Mergner. (*Elect. Engng, N.Y.*, Jan. 1954, Vol. 73, No. 1, pp. 41–45.) Direct voltages up to 500 V, direct currents down to 10^{-12}A and insulation resistance up to 10^8 MΩ are measured by a null method with maximum full-scale-deflection errors of 1·5, 3·5 and 5% respectively. The meter circuit includes a chopper-type stabilized feedback amplifier. To be published also in *Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72.

621.373.44 2183

Current-Step Waveform Generator.—V. A. Babits, S. R. Spengler & R. V. Morris. (*Electronics*, March 1954, Vol. 27, No. 3, pp. 164–167.) A circuit is described for producing stepped currents capable of providing stepped values of magnetic field such as are required, e.g. for rotating the plane of polarization in microwave experiments. The arrangement comprises voltage-step generator, pulse generator and output stage driving a coil of inductance 1·5–3 H.

621.387.001.4 2184

A Method of Testing Cold-Cathode Tubes.—D. L. Benson & D. H. Vogan. (*P.O. elect. Engrs' J.*, Jan. 1954, Vol. 46, Part 4, pp. 196–197.) In the usual methods of testing d.c. breakdown potential, using manual control, it is difficult to vary the potential across the gap at the optimum speed. An automatically operating circuit for this purpose is described.

621.396.6.002.2.001.4 2185

Standardization of Printed Circuit Materials.—Hannahs, Caffiauz & Stein. (See 2065.)

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

621.317.755 : 621.3.018.75 : 615.471 2186

A Time-Marker for Electrocardiography.—M. A. Bullen & L. A. Daynes. (*J. sci. Instrum.*, Jan. 1954, Vol. 31, No. 1, pp. 6–7.) A simple circuit using gas-filled counting tubes is described by means of which time-marking signals at four repetition rates between 5 and 100 per sec can be derived from a.c. mains or a suitable oscillator; the signals are superposed on the electrocardiograph displayed on the c.r.o. screen, no separate channel being required.

621.37 : 794 2187

Electronic Air-War Game simulates Missile Strikes.—L. I. Davis. (*Electronics*, April 1954, Vol. 27, No. 4, pp. 146–152.) Circuit arrangements are described for illustrating the main principles involved in air warfare. The two participants each have two electric potentials at their disposal, one of which controls the attack and the other the defence. The operating time scale is such as to enable logical decisions to be made regarding choice of targets, etc.

621.383.2 2188

Development of [electron-optical] **Image Converters and Image Intensifiers.**—F. Eckart. (*Ann. Phys., Lpz.*, 5th Jan. 1954, Vol. 14, Nos. 1/2, pp. 1–13.) Resolving power is estimated, particular designs, including two-stage types, are described, and applications are indicated.

621.384.611/.612 2189

A Synchrocyclotron with Fixed Operating Frequency.—F. Ollendorff. (*Elektrotech. u. Maschinenb.*, 1st Jan. 1954, Vol. 71, No. 1, pp. 10–15.)

621.384.611 2190

Cyclotron Oscillators and the Shifting Inter-Dee Ground Surface.—F. H. Schmidt & M. J. Jakobson. (*Rev. sci. Instrum.*, Feb. 1954, Vol. 25, No. 2, pp. 136–139.) The push-pull mode of oscillation of a two-dee cyclotron can be described in terms of a ground potential surface between the dees. Unbalance in dee voltages can be interpreted as a shift of the position of the ground surface. The electrical implications of a particular adjustment can by application of this concept be quickly evaluated by the cyclotron operator.

621.385.833 2191

Calculation of some Magnetic and Electric Fields with Cylindrical Symmetry.—Y. Axner. (*Appl. sci. Res.*, 1954, Vol. B4, Nos. 1/2, pp. 124–136.) Fields having cylindrical symmetry and also mirror symmetry with respect to a median plane are discussed; the field strength in the median plane is given. Solutions are presented in the form of power expansions; analytical solutions are obtained when the field strength in the median plane as a function of the radius is given by a polynomial.

621.385.833 2192

Investigation of the Mechanism of the Formation of the Image in an Electron Microscope.—I. G. Stoyanova & A. I. Frimer. (*C. R. Acad. Sci. U.R.S.S.*, 21st Jan. 1954, Vol. 94, No. 3, pp. 459–462. In Russian.) Experimental investigation of the dependence of the image contrast on the thickness of the specimen and on the electron energy, in dark-field and bright-field image presentations.

621.387.4 2193

The New Counters.—S. C. Curran. (*Sci. Progr.*, Jan. 1954, Vol. 42, No. 165, pp. 32–45.) A review of developments in particle counters, with 47 references.

621.387.424 2194

Velocity of Discharge Propagation in Self-Quenching Geiger-Müller Counters.—P. A. C. Mortier & J. F. Roose. (*Proc. phys. Soc.*, 1st Feb. 1954, Vol. 67, No. 410B, pp. 161–163.)

PROPAGATION OF WAVES

538.566 : 551.594.6 2195

The Higher-Order Modes in the Propagation of Long Electric Waves in the Earth-Air-Ionosphere System and Two Applications (Horizontal and Vertical Dipole.)—W. O. Schumann. (*Z. angew. Phys.* Jan. 1954, Vol. 6, No. 1, pp. 35–43.) Expressions for the propagation and the radiation intensities of higher-order modes of very long (>3 km) waves are derived and applied. For very long waves the Bessel functions can be approximated by exponential terms. The numerical illustrations include the case of lightning signals. See also 1544 of May.

538.566.3 2196

Propagation of Plane Electromagnetic Waves in a Homogeneous Plasma (Ionosphere).—R. Jancel & T. Kahan. (*J. Phys. Radium*, Jan. 1954, Vol. 15, No. 1, pp. 26–33.) Mathematical analysis based on magneto-ionic theory developed previously (1030 of April). Refractive index, double refraction, phase and group velocities, attenuation, polarization and critical frequencies are studied. The range of validity of classical formulae relating to ionospheric propagation is discussed.

621.396.11 2197

Diffraction of Plane Radio Waves by a Parabolic Cylinder.—S. O. Rice. (*Bell Syst. tech. J.*, March 1954, Vol. 33, No. 2, pp. 417–504.) Expressions are given for the diffraction field far behind, and the surface currents

on, a parabolic cylinder. Approximate values for the field strength and current density are given for the case when the radius of curvature of the cylinder is large compared with λ. The method of analysis makes use of parabolic cylinder functions of large complex order. The results indicate that the knife-edge representation is valid even for gently rounded hills when the angle of diffraction is small, but that the formulae developed are applicable to calculation of the shadows cast by hills in microwave propagation when the angle of diffraction is so large that the knife-edge representation is invalid.

621.396.11 : 535.15 2198

Birefringence in Crystals and in the Ionosphere.—C. H. M. Turner. (*Canad. J. Phys.*, Jan. 1954, Vol. 32, No. 1, pp. 16–34.) Propagation of plane e.m. waves in the ionosphere is compared with that in an optically inactive crystal, as in the work of Lange-Hesse (2868 of 1952); damping due to collisions of electrons with other particles is taken into account. In the ionosphere the plane wave is always characterized by three components of the field vectors, one of which is linearly polarized along the direction of the uniform magnetic field while the other two are circularly polarized in opposite senses in the plane perpendicular to the magnetic field.

621.396.11 : 551.510.535 2199

Oblique Propagation of Radio Waves over a Curved Earth.—B. Chatterjee. (*Indian J. Phys.*, May 1953, Vol. 27, No. 5, pp. 257–268.) Booker's analysis of oblique propagation (*Phil. Trans. A*, 1938, Vol. 237, pp. 411–451) is extended to take account of the earth's curvature by introducing appropriate correction factors. The values obtained for group retardation, attenuation and lateral deviation in the refracting region are higher than those for the flat earth and are in better agreement with experimental results.

621.396.11.029.51 2200

The Ionospheric Propagation of Radio Waves of Frequency 30-65 kc/s over Short Distances.—R. N. Bracewell, J. Harwood & T. W. Straker. (*Proc. Instn elect. Engrs*, Part IV, Feb. 1954, Vol. 101, No. 6, pp. 154–162. Digest, *ibid.*, Part III, March 1954, Vol. 101, No. 70, pp. 108–110.) Experiments carried out at Cambridge on waves reflected from the ionosphere at steep incidence are described. The phases and amplitudes of two linearly polarized components of the downcoming wave were measured with reference to the ground wave. Results are compared with those obtained by Straker for 16-kc/s waves, and show that (*a*) the day-to-day variations of the downcoming wave were greater at the higher frequencies, (*b*) the change in height of reflection in passing from day to night was about the same for all the frequencies, (*c*) the amplitudes by day and night in summer were very different, except at 16 kc/s, and (*d*) the polarization at all the frequencies was approximately circular, left-handed and constant.

621.396.11.029.62 : 621.396.812 2201

U.S.W. Extended-Range [propagation] **and Inversions.**—H. Wisbar. (*Funk-Technik, Berlin*, Jan. 1954, Vol. 9, No. 1, pp. 8–10.) Reception and transmission over abnormally long distances by a North-West German amateur station operating in the 2-m band, in the period from March to October 1953, is correlated with meteorological conditions, particularly barometric pressure systems. Propagation distances up to 1 100 km were recorded. The effect of widespread fog is also noted.

621.396.11.029.62 : 621.397.5 2202

Wave Propagation and Television Broadcasting at Very High Frequencies.—Smith-Rose. (See 2234.)

621.396.81 + 621.396.65 2203

Microwave as Applied to Railroad Operation in the Gulf Coast Area.—Thomas. (See 2219.)

621.396.82.029.62 2204

Prediction of the Likelihood of Interference at Frequencies of 30 to 42 Megacycles in Alaska.—T. N. Gautier, Jr, & C. J. Sargent. (*J. Res. nat. Bur. Stand.*, Jan. 1954, Vol. 52, No. 1, pp. 21–31.) A full report is presented of an investigation of the likelihood of interference with the operation of a proposed v.h.f. line-of-sight network, either from ionospheric propagation of signals between stations of the network, or from stations outside the network. Diurnal, seasonal and sunspot-cycle variations are studied. The likelihood of interference is inferred from the likelihood of occurrence of m.u.f.s equal to or greater than the operation frequencies. Calculations were made for paths involving reflections from (*a*) the F_2 layer and (*b*) the sporadic-E layer.

RECEPTION

621.396.621 : [523.2/.8 : 621.396.822 2205

A D.C. Comparison Radiometer.—W. Selove. (*Rev. sci. Instrum.*, Feb. 1954, Vol. 25, No. 2, pp. 120–122.) Apparatus for measuring r.f. radiation from astronomical sources is described in which a comparison signal is transmitted through the receiving system along with the incoming signal, as a means of measuring the gain of the system and of cancelling the effect of gain fluctuations. The two signals are separated at the receiver output by a pair of filters. The rectified outputs of the two filters are compared, and the difference constitutes the final output signal. For a signal with bandwidth narrow compared with the receiving system bandwidth, the maximum improvement attainable over the switching-type comparison radiometer is 3·2 db.

621.396.621 : 621.314.7 2206

An Experimental Transistor Personal Broadcast Receiver.—L. E. Barton. (*Trans. Inst. Radio Engrs*, Jan. 1954, No. PGBTR-5, pp. 6–13.) Details are given of an a.m. receiver using 6 r.f. junction transistors of the type described in 1955 of June (Mueller & Pankove), three conventional junction transistors for class-B audio driver and output stages, and two diodes. Battery drain is <12 mA, and maximum output is 150 mW. Sensitivity and signal/noise ratio are comparable to those of conventional receivers.

621.396.621 : 621.372.2 2207

The History of the Homodyne and Synchrodyne.—D. G. Tucker. (*J. Brit. Instn Radio Engrs*, April 1954, Vol. 14, No. 4, pp. 143–154.) An account is given of the independent development of the synchronous demodulation system from Colebrook's homodyne and from Tucker's synchrodyne. 62 references.

621.396.621 : 621.396.822 2208

The Minimum Detectable Change in the Mean Noise-Input Power to a Radio Receiver.—D. G. Lampard. (*Proc. Instn elect. Engrs*, Part IV, Feb. 1954, Vol. 101, No. 6, pp. 118–128. Digest, *ibid.*, Part III, March 1954, Vol. 101, No. 70, pp. 111–113.) Expressions for the minimum detectable change involving only the pre-detector and the post-detector filter responses have been derived for receivers using either a power-law instantaneous detector (full- or half-wave type) or an ideal power-law envelope detector. Using these expressions and making appropriate approximations, an example, in which the pre-detector filter is a single tuned circuit and the post-detector filter is a simple *RC* integrator, is

worked out in detail. The results, presented in simple form, show clearly the effect of the filter bandwidths and the detector law on the sensitivity of the receiver to changes in noise input power.

621.396.662.078 **2209**

A Wideband Searching Automatic Frequency Control Circuit of New Type.—H. Wallman. (*Chalmers tek. Högsk. Handl.*, 1953, No. 132, 21 pp.) A system in which the local oscillator automatically 'searches' a wide frequency range to locate its correct frequency before the a.f.c. operates, cannot be based on a simple i.f. discriminator. In the system described the frequency-sensing element is an i.f. resonant circuit with a detector and a circuit differentiating the detector output with respect to time. Frequency search is effected by a motor-driven coarse-tuning capacitor; an appropriate output from the differentiator actuates a multivibrator which changes the phase of the motor supply, causing the motor to reverse. The coarse-tuning capacitor stops and a fine-tuning capacitor is engaged. The continued presence of a signal gives a periodic output from the differentiator so that the latter capacitor oscillates back and forth every second through about $\pm 10°$. Over this range a free-play gear operates so that the coarse-tuning capacitor is at rest. The system has important application at u.h.f. Details are given of a model operated at 2·4 Mc/s with an automatic search range of 500 kc/s.

621.396.722 : 621.317.3 **2210**

The B.B.C. Measurement and Technical Receiving Station at Tatsfield.—H. V. Griffiths. (*B.B.C. Quart.*, Spring 1954, Vol. 9, No. 1, pp. 43–56.) The development, functions and equipment of the station are described. Work undertaken is classified under eight main headings. It involves measurement of frequency (mainly carrier frequencies between 150 kc/s and 150 Mc/s), field strength, and atmospheric noise; relaying programmes for broadcast or transcription; interference identification and programme-schedule checking; d.f. and wave angle measurements; measurement of modulation depth and sideband dispersion. Frequency-checking procedure and apparatus in particular are noted. Four frequency standards are maintained.

621.396.828 **2211**

Funk-Entstörung. [Book Review]—F. Seelemann. Publishers: O. Elsner, Darmstadt, 1954, 832 pp., DM56. (*Frequenz*, Feb. 1954, Vol. 8, No. 2, pp. 61–62.) Published on behalf of the Federal German Post Office. Sources of radio interference are discussed and methods of measurement and suppression described. A chapter is devoted to the construction of low-interference electrical apparatus and machines.

STATIONS AND COMMUNICATION SYSTEMS

621.376.2 **2212**

A General Solution of the Two-Frequency Modulation Product Problem: Part 1.—R. L. Sternberg & H. Kaufman. (*J. Math. Phys.*, Jan. 1954, Vol. 32, No. 4, pp. 233–242.) A method is presented for readily obtaining approximate numerical values of the amplitudes of the modulation products occurring in the output of an arbitrary modulator with continuous output/input characteristic, to which a two-frequency input is applied. A partial analytical solution of the problem is also given. Exact values are obtainable in cases such as that of the biased ideal rectifier considered by Bennett (3506 of 1947).

621.376.3.015.7 **2213**

Frequency Spectra of Individual H.F. Pulses with Varying Carrier Frequency.—S. I. Bytschkow. (*NachrTech.*, Jan. 1954, Vol. 4, No. 1, pp. 7–13.) Translated from *Radiotekhnika, Moscow*, 1950, Vol. 5, No. 1. Analytica expressions are derived for the spectral density for different types of variation of the carrier frequency during the pulse; a graphical method for finding the spectrum is given. The choice of receiver bandwidth for such systems is discussed.

621.39 + 621.317] : 519.213 **2214**

Probability of Causal Events in Telecommunications and Measurement Technique.—J. Loeb. (*Ann. Télécommun.*, Jan. 1954, Vol. 9, No. 1, pp. 15–19.) Application of Bayes' Law to the calculation of Shannon's equivocation $H_y(x)$ and to the matching of a source to a channel with noise.

621.39.001.11 **2215**

Two Types of Error due to Noise.—J. Loeb. (*Ann. Télécommun.*, Feb. 1954, Vol. 9, No. 2, pp. 29–34.) Probability theory (2214 above) is discussed in relation to binary-code telegraphy, when the probability of mistaking a signal for noise is quite independent of the probability of accepting a noise voltage as a signal. The effect of additive and multiplicative iteration techniques on the probability of error is examined. According to a 'principle of complements', for a given signal/noise ratio no receiver modification can give a simultaneous reduction of the two types of error.

621.39.001.11 **2216**

Geometric Aspects of Least Squares Smoothing.—A. A. Hauser, Jr. (*Proc. Inst. Radio Engrs*, April 1954, Vol. 42, No. 4, pp. 701–704.) Function space techniques used by Shannon and Zadeh to clarify concepts in communication theory are considered. "An understanding of the operation of a least squares smoother is enhanced by establishing an m-dimensional space in which inputs and outputs are vectors and the smoother is a transformation. The concept of transmission and rejection manifold as established by Zadeh is introduced and the manner in which signal and noise are separated is illustrated geometrically. An explicit pictorial representation of the process is given for the three dimensional case."

621.395.44 : 621.315.212 **2217**

S900-101 Coaxial-Pair Equipment.—(*Câbles & Transm.*, Jan. 1954, Vol. 8, No. 1, pp. 4–125.) A series of articles gives details of the planning of the system used in France, of the design of certain individual items of equipment for repeater and terminal stations and of gear for servicing, testing and maintenance work.

621.396.4 : 621.396.65 **2218**

Experimental Radio Bearer Equipment for Carrier Telephone Systems.—W. S. McGuire & A. G. Bird. (*J. Brit. Instn Radio Engrs*, April 1954, Vol. 14, No. 4, pp. 171–188.) Reprint. See 3412 of 1953.

621.396.65 + 621.396.81 **2219**

Microwave as Applied to Railroad Operation in the Gulf Coast Area.—L. R. Thomas. (*Elect. Engng, N.Y.*, Jan. 1954, Vol. 73, No. 1, pp. 63–67.) A radio link for a path of approximately 70 miles and comprising two terminal and three repeater stations is described. Eight p.a.m. channels are provided; the equipment operates in the 6·7-kMc/s range. Propagation tests over a period of nearly two years show that, even when the aerial heights have been suitably chosen, fading may be experienced due to (*a*) temperature inversions or changes in humidity, and (*b*) fog at one of the station sites. To be published also in *Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72.

621.396.65 **2220**

Carrier-Current Radio Links in the Light of C.C.I.F. Recommendations.—J. P. Vasseur. (*Ann. Radioélect.*,

Jan. 1954, Vol. 9, No. 35, pp. 47–82.) C.C.I.F. recommendations in respect of signal/noise and signal/crosstalk ratios are considered in relation to f.m. links. The noise contribution of each element in the transmission chain is assessed, and the minimum performance required of each element specified. A 2 500-km f.m. link will require careful planning if it is to satisfy C.C.I.F. requirements. Sine-wave signals are suitable for testing individual elements, but noise-modulated sine-wave signals are preferable for overall tests of the complete link.

621.396.97 : 621.397.24/.26 2221

Technical Arrangements for the Sound and Television Broadcasts of the Coronation Ceremonies on 2nd June, 1953.—Procter, Pulling & Williams. (See 2231.)

SUBSIDIARY APPARATUS

621-526 : 621.3.015.7 2222

The Pulse Transfer Function and its Application to Sampling Servo Systems.—R. H. Barker. (*Proc. Instn elect. Engrs*, Part IV, Feb. 1954, Vol. 101, No. 6, pp. 162–163.) Discussion on 1131 of 1953.

621.3.013.783.001.4 2223

Measuring the Effectiveness of Shielding Materials.—C. DeVore. (*Elect. Mfg*, Aug. 1953, Vol. 52, No. 2, pp. 122–125.) A method developed at the U.S. Naval Research Laboratory is described. Only a small sample of the material under test, e.g. wire mesh or conducting coating, is needed. The sample is inserted between two shield cans containing transmitting and receiving aerials respectively, and the attenuation increase produced by the sample is observed. The frequency range investigated is 15 kc/s–100 Mc/s; it may be possible to extend the method to higher frequencies by using waveguide technique.

621.314.57 : 621.387 2224

Thyratron Inverter.—J. D. Howells. (*Wireless World*, May 1954, Vol. 60, No. 5, pp. 237–241.) Description of a unit giving 100 W at 240 V, 50 c/s from d.c. mains.

621.314.6 2225

Rectifier with Smoothing Capacitor and High-Vacuum Valves or Selenium Rectifiers.—K. Müller-Lübeck. (*Arch. Elektrotech.*, 1954, Vol. 41, No. 4, pp. 181–195.) Exact equations are derived for a p-phase rectifier circuit with a capacitance connected across the load. For practical use approximate formulae are derived, and their application is illustrated by the design of a two-phase rectifier for an output of 2·25 kV, 0·7 A.

621.314.63 + 621.316.93] : 546.28 2226

Silicon *P*-*N* Junction Power Rectifiers and Lightning Protectors.—G. L. Pearson & C. S. Fuller. (*Proc. Inst. Radio Engrs*, April 1954, Vol. 42, No. 4, p. 760.) A method of preparing large-area-junction diodes is indicated, in which donor (e.g. P) or acceptor (e.g. B) impurities are diffused into high-purity single crystals of Si at temperatures above 1 000°C. Low-resistivity surface layers are produced, facilitating the application of contacts. Electrical characteristics are presented of a power rectifier and a lightning protector prepared by this method.

621.316.722.1 2227

A Simple Mains Unit for Highly Constant Alternating Voltages and Currents.—H. Helke. (*Elektrotech. Z., Edn A*, 1st Jan. 1954, Vol. 75, No. 1, pp. 11–13.) A unit giving a voltage continuously variable up to 600 V and currents up to 6 A is described, the voltage varying not more than ±0·1% with mains voltage variations up to ±10% and mains frequency variations up to 0·5%.

621.316.722.1 2228

A New D.C. Electronic Voltage-Stabilizing Circuit.—R. B. Mackenzie. (*Proc. Instn elect. Engrs*, Part II, Feb. 1954, Vol. 101, No. 79, pp. 59–63.) The detecting element across the supply consists of a negative-resistance and a positive-resistance element of equal numerical values in series. By controlling the negative resistance complete compensation can be achieved. A circuit built on a similar principle but using a different type of negative-resistance element was described by Patchett (227 of 1951). A stabilizer with an output of 400 V is described in detail; the output can be maintained constant to within ±0·001% for an input fluctuation of ±10% and a load variation of 1–20 mA. The circuit is suitable for voltages from 70 V upwards.

621.318.5 2229

Relay Standardization.—(*Elect. Mfg*, Sept. 1953, Vol. 52, No. 3, pp. 146–154..380.) Summarized report of proceedings of symposium on e.m. relays, held at Oklahoma in June 1953. Military applications were the main consideration.

621.355 2230

Recent Patents on Electrical Accumulators.—L. Jumau. (*Rev. gén. Élect.*, Feb. & March 1954, Vol. 63, Nos. 2 & 3, pp. 59–70 & 129–142.) Review of developments. For previous review see 3177 of 1950.

TELEVISION AND PHOTOTELEGRAPHY

621.397.24/.26 : 621.396.97 2231

Technical Arrangements for the Sound and Television Broadcasts of the Coronation Ceremonies on 2nd June, 1953.—W. S. Procter, M. J. L. Pulling & F. Williams. (*Proc. Instn elect. Engrs*, Part I, March 1954, Vol. 101, No. 128, pp. 57–72. Discussion, pp. 73–78.) A comprehensive description of the arrangements and equipment used for the simultaneous broadcasts to the United Kingdom and parts of Western Europe. An account is included of the sound and television recording arrangements of the B.B.C. and the North American organizations, which enabled telerecordings to be screened in America within 11 hours of the event. See also 2804 of 1953 (Bridgewater).

621.397.26 2232

U.H.F.-TV Satellite Operation.—J. S. Allen. (*Sylvania Technologist*, Jan. 1954, Vol. 7, No. 1, pp. 3–7.) An unattended system is described consisting of two transmitters, one on a hilltop and the other about 1½ miles away in the small town to be served. Programmes picked up at the hilltop station are re-broadcast on channel 22 (518–524 Mc/s) and relayed by low-power microwave link to the town transmitter, broadcasting on channel 82 (878–884 Mc/s).

621.397.335 2233

Portable Sync Generator for TV Broadcasting.—H. E. Ennes. (*Electronics*, April 1954, Vol. 27, No. 4, pp. 138–141.) Description, including detailed circuit diagram, of equipment using 22 miniature valves and providing a standard R.E.T.M.A. synchronizing signal at 4 V negative peak to peak across 75Ω.

621.397.5 : 621.396.11.029.62 2234

Wave Propagation and Television Broadcasting at Very High Frequencies.—R. L. Smith-Rose. (*Proc. Instn Radio Engrs, Aust.*, Jan. 1954, Vol. 15, No. 1, pp. 7–12.) "The fundamental factors determining the bandwidth of a television system are reviewed and the present arrangement of the v.h.f. channels in the B.B.C. service is outlined. Experiments on the propagation of radio

waves over various distances in the frequency range 30 to 100 Mc/s are then described and the results related to the problem of extending the service by means of shared channels."

621.397.5(083.74)(931) 2235

The Choice of a Television Standard.—N. R. Palmer. (*Radio & Electronics, Wellington, N.Z.*, 1st Feb. 1954, Vol. 8, No. 12, pp. 17–19.) Discussion of various considerations affecting the choice of appropriate standards for operation in New Zealand. The only difference between the New Zealand recommendations and standard British practice was in the choice of horizontal polarization. The frequency channels recommended were 48–53 Mc/s for Wellington, 53–58 Mc/s for Dunedin, 58–63 Mc/s for Christchurch and 63–68 Mc/s for Auckland.

621.397.61 : 535.316/.319].001.4 2236

The Measurement of the Performance of Lenses.—W. N. Sproson. (*B.B.C. Quart.*, Spring 1953, Vol. 8, No. 1, pp. 55–64.) Lenses for television cameras and other television purposes are discussed.

621.397.611 : 778.5 2237

New Method for Television Film Scanning.—T. Stutz. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st Jan. 1954, Vol. 32, No. 1, pp. 1–27.) A comprehensive analysis is made of known methods, and a description is given of a continuous-motion picture projector using two optical systems in alternation. The film motion is compensated by moving the axes of the optical systems alternately forward and backward with respect to the film travel. The arrangement is used in conjunction with a flying-spot scanner.

621.397.611 : 778.5 2238

New 35-mm Television Film Scanner.—E. H. Traub. (*J. Soc. Mot. Pict. Telev. Engrs*, Jan. 1954, Vol. 62, No. 1, pp. 45–54.) A flying-spot system with continuous exposure and continuous film motion combined with optical compensation by means of a new type of rotating-prism device is described.

621.397.611.2 2239

The Supericonoscope IS 9 mm/10.—R. Just. (*Radio Tech., Vienna*, Jan. 1954, Vol. 30, No. 1, pp. 13–21.) Detailed description of a recently developed German camera tube with magnetic deflection and focusing systems. Associated supply, scanning and protection circuits are shown and operating characteristics are discussed, particularly sensitivity and performance at different levels of illumination.

621.397.611.2 : 537.531 2240

X-Ray Noise Observation using a Photoconductive Pickup Tube.—A. D. Cope & A. Rose. (*J. appl. Phys.*, Feb. 1954, Vol. 25, No. 2, pp. 240–242.) X-ray images have been recorded directly using a vidicon tube with Se target 0·001-in. thick. Noise effects due to the absorbed photons are clearly visible. Clear transmitted pictures at a rate of 30/sec were obtained when irradiating the vidicon with a 5-mA 100-kV beam at a distance of 2 ft.

621.397.62 2241

An Outline of the British Television System: Part 3 — Receiving the Picture Waveform.—D. Wray. (*P.O. elect. Engrs' J.*, Jan. 1954, Vol. 46, Part 4, pp. 166–170.) Typical aerials and circuits for domestic receivers are described; the effects of receiver faults and external interference on reception are discussed. Part 2: 873 of March.

621.397.62 2242

Band III Convertor.—G. H. Russell. (*Wireless World*, May 1954, Vol. 60, No. 5, pp. 211–213.) A simple circuit for adapting Band-I television receivers to accommodate either of the two proposed British Band-III television channels uses a self-oscillating type of mixer whose output is fed to the receiver via a step-down i.f. transformer. Details are given of components and alignment procedure.

621.397.62 2243

Signal Overload Relay for Television Receivers.—C. Masucci, J. R. Peltz & W. B. Whalley. (*Electronics*, April 1954, Vol. 27, No. 4, pp. 153–155.) When a high-sensitivity receiver is operated in an area where alternative strong and weak signals are available, it is desirable to make provision for automatically reducing the gain for the strong signal and restoring it for the weak one; the same arrangement can be used simply to prevent overloading. The device described consists of a relay in the r.f. and i.f. anode circuits which is arranged to cut out the r.f. amplifier valve when the a.g.c. voltage reaches a set level.

621.397.62 : 535.623 2244

Color Decoder Simplifications based on a Beam Deflection Tube.—R. Adler & C. Heuer. (*Trans. Inst. Radio Engrs*, Jan. 1954, No. PGBTR-5, pp. 64–70.) In a synchronous demodulator for the N.T.S.C. two-component colour signal, the usual multigrid valve is replaced by a beam valve; one signal component is applied to a conventional control grid, and the other to a deflection control system. Circuit arrangements and experimental results are presented.

621.397.62 : 535.623 2245

TV Color Detectors use Pulsed-Envelope Method.—K. Schlesinger. (*Electronics*, March 1954, Vol. 27, No. 3, pp. 142–145.) Synchronous detection of the two quadrature components of the N.T.S.C. colour signal is accomplished by means of rectifiers, which may be conventional diodes or triodes, keyed in and out by a local oscillator. Balanced and unbalanced arrangements are described. See also *Trans. Inst. Radio Engrs*, Jan. 1954, No. PGBTR-5, pp. 53–63.

621.397.62 : 621.385.832 : 537.531 2246

The Production of X Rays by Television C.R. Tubes.—K. H. J. Rottgardt. (*Fernmeldetech. Z.*, Feb. 1954, Vol. 7, No. 2, pp. 74–75.) X-ray film measurements on the Valvo MW 36-44, the Lorenz Bs 42 R-3 and Bs 42 R-6 c.r. tubes, at anode voltages $>$ 16 kV, indicate that the amount of X-ray radiation penetrating the glass envelope is negligible. An editorial note adds that the radiation intensity from a 15-kV tube was equivalent to that from 1 μg Ra, i.e. of the same order as that from a luminous watch dial.

621.397.621.018.75 2247

Development of Television Pulse-Regeneration Equipment.—K. H. Vogt. (*Fernmeldetech. Z.*, Feb. 1954, Vol. 7, No. 2, pp. 53–55.) Description of equipment used at Höhbeck relay station. For a description of similar equipment see 558 of February (Dröscher).

621.397.621.2 : 535.623: 535.37 2248

The Preparation of Phosphor Screens for Color Television Tubes.—S. Levy & A. K. Levine. (*J. electrochem. Soc.*, Feb. 1954, Vol. 101, No. 2, pp. 99–103.) See 3440 of 1953.

621.397.813 2249

'Sensation-Correct' Gamma Correction of Television Pictures.—P. R. Arendt. (*Arch. elekt. Übertragung*,

Jan. 1954, Vol. 8, No. 1, pp. 1–4.) Results of subjective tests indicate that equalization to unity gamma causes a distortion of the half-tone scale. The construction of subjectively correct equidistance brightness scales for given adaptation levels is discussed.

621.397.828 2250

Beat between Sound Carrier and Color Signal Components in a Television Receiver.—J. E. Allen. (*Trans. Inst. Radio Engrs*, Jan. 1954, No. PGBTR-5, pp. 71–86.) Reception of signals conforming to the N.T.S.C. standards is discussed. Analysis of the beat produced in the detector between the sound carrier and the colour subcarrier, and visible as streaks in the picture, shows that the sound carrier attenuation must be at least 14 db greater than the desired reduction in beat level below a full black-to-white transition. Tests show that 30-db attenuation is required for beat suppression. The sound level must therefore be at least 44 db below mid-band response. To allow for transmission variations, a further margin should be provided. The requirement is more easily realizable in a receiver with a response curve sloping so as to reduce the response to the colour subcarrier. Effects of the beat in the chrominance channel are simultaneously suppressed.

TRANSMISSION

621.376.32 2251

Frequency Modulation of Microwaves.—S. Freedman. (*Radio & Telev. News, Radio-Electronic Engineering Section*, Jan. 1954, Vol. 51, No. 1, pp. 16–18.) Direct frequency modulation of the carrier frequency in a system comprising microwave generator and resonant cavity is achieved by altering the dimensions of the resonant cavity. One wall of the cavity consists of a light framework supporting a series of concentric wire rings. This framework replaces the cone in a loudspeaker, and vibrates when a.f. signals are applied to the loudspeaker. The vibrating wall is not in electrical connection with the main body of the cavity. A TE_{0n} mode must be used. Modifications may be made so that the system operates as an a.f.c. unit.

621.396.61 2252

High Power H.F. Broadcast Transmitters.—D. F. Bowers & J. F. Ennos. (*Marconi Rev.*, 1st Quarter 1954, Vol. 17, No. 112, pp. 16–36.) A detailed account is given of the design of a series of 100-kW transmitters Type BD.253 for the frequency bands 160–285 kc/s, 525–1 605 kc/s and 5·9–26·1 Mc/s respectively. Good overall efficiency is obtained by using valves with thoriated tungsten filaments; air cooling is used. Valve filaments are heated by a.c., and hum is reduced by feedback. Hot-cathode Hg-vapour rectifiers provide the h.v. supply.

621.396.61 2253

Design of Transmitter Power Stages from Valve Data (with Formulae).—W. Lacmann. (*Frequenz*, Dec. 1953, Vol. 7, No. 12, pp. 369–375.) Formulae for calculating operating conditions for these circuits are presented, based mainly on applied anode voltage, maximum anode dissipation and maximum emission current as parameters. It is assumed that the valve is operated so that the voltage drop across it is a minimum consistent with maximum anode current, but modifications to the formulae are indicated for other cases. Diagrams are given from which efficiency can be estimated under various operating conditions. The practical application of the formulae is illustrated for power amplifier and frequency-doubler stages.

621.396.61 : 621.314.7 2254

160-Metre Transistor Transmitter.—A. Cockle. (*Wireless World*, May 1954, Vol. 60, No. 5, p. 217.) A Type-OC51 transistor (alpha cutoff at 1·5 Mc/s) is used in an amateur transmitter employing the negative-resistance base-oscillator principle and locked over about 1 kc/s by a 1·8 Mc/s crystal. With power up to 100 mW, signals have been received at distances up to 30 miles.

621.396.61.029.58 : 621.396.65 2255

Single-Sideband Multi-Channel Operation of Short-Wave Point-to-Point Radio Links: Part 4(b) — An Independent-Sideband High-Power Short-Wave Transmitter — Design and Performance.—H. E. Sturgess & F. W. Newson. (*P.O. elect. Engrs' J.*, Jan. 1954, Vol. 46, Part 4, pp. 191–195.) Part 4(a): 882 of March.

621.396.61.029.62 2256

V.H.F./U.H.F. Transmitters for Experimental Work.—(*Elect. J.*, 26th March 1954, Vol. 152, No. 13, pp. 1031–1032.) A band-III transmitter for use by the B.B.C. is described. Square-waveform modulation at 1 kc/s is provided for purposes of field strength measurements, and pulse modulation for investigation of multipath transmission and echo effects. Only one r.f. circuit is used for both conditions of modulation. The transmitter is intended for operation in a van, and the power-supply unit is accordingly designed to deal with large variations of mains supplies. The output is 150 W c.w. The development of another band-III transmitter and of band-IV and band-V transmitters is mentioned.

VALVES AND THERMIONICS

621.314.632 : 546.289 : 621.374 2257

"Positive-Gap" Germanium Diode.—A. H. Reeves. (*Onde élect.*, Jan. 1954, Vol. 34, No. 322, pp. 32–37.) A suitable point contact, such as Ag with As impurity, and a suitable electrical forming technique produce a discontinuity in the diode forward characteristic useful in pulse techniques. Its application in a 20-Mc/s pulse generator and in counting and trigger circuits operating at higher frequencies is illustrated.

621.314.7 2258

The Theory of Physical Principles involved in the A-Type Transistor Action.—Y. Watanabe & N. Honda. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser.B*, Dec. 1952, Vol. 4, No. 1, pp. 117–163.) Detailed consideration of the nature of the barrier layer of the collector contact and the mechanism of rectification of high-back-voltage Ge rectifiers, and of the mechanism of transistor action principally in *n*-type Ge. A comparison of the theoretical results with the experimental results of Bardeen & Brattain (2979 of 1949) shows satisfactory agreement. The current feedback factor is also considered.

621.314.7.001.4 2259

Measuring Transistor Temperature Rise.—J. Tellerman. (*Electronics*, April 1954, Vol. 27, No. 4, pp. 185–187.) The temperature rise as a function of the power dissipation is determined by noting the change in the reverse collector current, for zero emitter current. Circuits are illustrated for providing an oscilloscope or a meter indication of collector current. Experiments with Type 2520 and 2521 transistors using various cooling arrangements showed that the temperature rise could be reduced from about 26° to about 20° above an ambient temperature of 27°C, thus permitting an increase of 25–30% in the power dissipation.

621.314.7.012.6 : 621.317.755 2260

Characteristic-Curve Tracer for Transistors.—H. Lennartz. (*Funk u. Ton*, Jan. 1954, Vol. 8, No. 1, pp.

25–29.) Description of equipment used in conjunction with a c.r.o.

621.383.2 **2261**

Alkali Photocells: Part 2.—M. Ploke. (*Arch. tech. Messen*, Jan. 1954, No. 216, pp. 15–18.) 70 references. Part 1: 1608 of May.

621.385.029.63/.64 **2262**

On the Focusing of High-Current Electron Beams.—G. R. Brewer. (*J. appl. Phys.*, Feb. 1954, Vol. 25, No. 2, pp. 243–251.) The trajectories of electrons under the influence of magnetic and space-charge forces in a system of periodically spaced magnetic lenses are determined. Graphs are presented for use in designing a focusing system for given values of current, voltage, and beam diameter. Use of multiple magnetic-lens systems of the type investigated offers considerable economies over the use of long focusing coils for travelling-wave valves.

621.385.032.2 : 537.533.9 **2263**

Some Effects of Slow Electron Bombardment in Thermionic Valves.—D. A. Wright. (*Brit. J. appl. Phys.*, March 1954, Vol. 5, No. 3, pp. 108–111.) A review of recent work. See also 1748 of June (Wright & Woods).

621.385.032.216 **2264**

Decay of Emission from an Oxide-Coated Cathode due to Adsorption of Matter liberated from the Anode.—S. Deb. (*J. Brit. Instn Radio Engrs*, April 1954, Vol. 14, No. 4, pp. 157–167.) Two types of adsorption procedure are distinguished, (*a*) when the adsorbed particles remain mobile on the surface, (*b*) when the adsorbed particles are immobile. Equations for the decay processes in the two cases are given in integral form and are solved numerically using estimated values of the constants involved. An approximate analytical solution is also given for case (*a*). The decay in this case is generally of short duration and the emission current is likely to recover spontaneously, whereas in case (*b*) the decay is of long duration and is likely to be permanent. Differences between the pulsed and d.c. behaviour are explained on the hypothesis that the poisoning of the cathode is only temporary in the pulsed case.

621.385.032.216 **2265**

On the Crystallizations of Alkaline Earth Carbonates and Effects of Sizes and Shapes of these Crystals on the Oxide-Coated Cathodes.—H. Nukiyama, E. Takagi & A. Sato. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, Dec. 1952, Vol. 4, No. 1, pp. 87–103.) The principal conclusions of this experimental investigation are: (*a*) in the crystallization of carbonates by the precipitation method, temperature, concentration of reactants and pH of precipitant are important, (*b*) the velocity of decomposition into oxides on heating in vacuum depends mainly on the shape rather than the size of the crystals, and (*c*) thermionic emission is not strongly influenced by crystal shape or size.

621.385.2 **2266**

Test of Langmuir's Three-Halves Power Law, Deviations due to β^2-Factor and Secondary Emission.—P. L. Walraven. (*Appl. sci. Res.*, 1954, Vol. B3, No. 6, pp. 393–399.) Results of measurements on a cylindrical diode, in which the filament current and the anode voltage were interrupted alternately at a rate of 3 500/sec, indicate that there is a large deviation from Langmuir's law due to an additional space charge which is produced mainly by reflected electrons at anode voltages up to 30 V; the correction factor should then be $\beta^2(1 + 2\alpha)$ instead of β^2, where α is the reflection coefficient. For a Ta anode α is 14%. The correction for the space charge in a planar diode is also derived.

621.385.3.012 **2267**

Calculation of Characteristic Curves for Planar Triodes.—O. Heymann. (*Frequenz*, Feb. 1954, Vol. 8, No. 2, pp. 33–40.) Equations for the slope and valve current are derived from the valve geometry, taking into consideration the formation of 'islands' by the grid wires. The slope equation relates the cut-off potential to the grid-cathode distance and can conveniently be used as the starting point for valve design. The numerical values of the elliptic integrals occurring in the equations are shown graphically and tabulated. See also 3609 of 1952 (Dahlke).

621.385.8 **2268**

Approximate Electrode Shapes for a Cylindrical Electron Beam.—E. R. Harrison. (*Brit. J. appl. Phys.*, Jan. 1954, Vol. 5, No. 1, pp. 40–41.) With the aid of some approximations, a simple equation is derived for the shapes of electrodes to produce a parallel beam of rotational symmetry in which the current is space-charge limited. The method has been used for designing a proton-beam accelerator.

621.385.832 : 537.533 **2269**

The Geometrical-Optical Distribution of Intensity over the Focused Spot of the Deflected Electron Beam.—H. Grümm. (*Optik, Stuttgart*, 1954, Vol. 11, No. 1, pp. 32–43.) Analysis is presented which gives the approximate distribution with far less calculation than by the method based on wave mechanics.

621.385.832 : 621.317.755 **2270**

An Interesting Four-Beam Cathode-Ray Tube.—H. F. Wendling. (*Funk-Technik, Berlin*, Feb. 1954, Vol. 9, No. 4, pp. 102–103.) The single-gun oscillograph tube, Type V113, has a first cylindrical e.s. lens producing a ribbon beam; this is deflected as a whole by the e.s. horizontal-deflection system and is split into four in passing through the multiple e.s. vertical-deflection system, the individual ribbon beams being restored to pencil form by the multiple cylindrical lens constituted by the apertures of the vertical-deflection system in combination with the post-deflection accelerator.

621.396.822 : 537.533 **2271**

Cathode Boundary Conditions and Noise Minima in Electron Beams.—R. Wiesner & H. W. König. (*Arch. elekt. Übertragung*, Jan. 1954, Vol. 8, No. 1, pp. 5–7.) The assumption of the existence of a convection-current fluctuation at the cathode in addition to the velocity fluctuation leads to a theoretical noise distribution in good agreement with that found experimentally by Cutler & Quate (1274 of 1951). In particular the noise minima have values differing from zero.

MISCELLANEOUS

061.4 : [621.317.7 + 621.35 **2272**

Physical Society's Exhibition [1954].—(*Wireless Engr*, May 1954, Vol. 31, No. 5, pp. 132–136.) Brief descriptions are given of selected exhibits. See also *Elect. Times*, 8th April 1954, Vol. 125, No. 3257, pp. 506–509, and *Instrum. Practice*, March 1954, Vol. 8, No. 3, pp. 234–244.

621.37/.39 **2273**

Radio Progress during 1953.—(*Proc. Inst. Radio Engrs*, April 1954, Vol. 42, No. 4, pp. 705–759.) A review presented with the main purpose of giving specialist workers an idea of developments in fields other than their own. Over 1 100 references are given. The headings under which the material is arranged are almost identical with those used for the 1952 review.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.13 2274

Study of the Acoustic Properties of Granular Substances excited to Shear-Mode Vibrations.—M. L. Exner, W. Güth & F. Immer. (*Acustica*, 1954, Vol. 4, No. 2, pp. 350–358. In German.) Measurements of the mechanical impedance were made in the range 100–4 000 c/s on closely-packed granular carbon, using a rigid vibrometer. For small-amplitude vibrations the resonance frequencies are higher in fine-grain material and the damping less than in coarse-grain material. A decrease in velocity of propagation with increasing grain radius was observed. Results are in general agreement with those obtained by other methods.

534.2-14 2275

Wave Propagation in a Randomly Inhomogeneous Medium: Part 3.—D. Mintzer. (*J. acoust. Soc. Amer.*, March 1954, Vol. 26, No. 2, pp. 186–190.) The assumption of a restricted pulse length made in part 1 (931 of April) is examined. The conditions necessary for the assumption to be valid are investigated. The coefficient of variation for a series of sound pulses of arbitrary length and the correlation function for successively received pulses are evaluated. Part 2: 1633 of June.

534.21-13 2276

Finite Amplitude Sound produced by a Piston in a Closed Tube.—J. B. Keller. (*J. acoust. Soc. Amer.*, March 1954, Vol. 26, No. 2, pp. 253–254.) The one-dimensional equation of motion of a polytropic gas with adiabatic index $\gamma = -1$ is solved for an arbitrary piston motion. More detailed results are given for the case of sinusoidal motion. See also 294 of February.

534.213.4 2277

A Method of Measuring Discontinuity Effects in Ducts.—W. K. R. Lippert. (*Acustica*, 1954, Vol. 4, No. 2, pp. 307–312.) The method is based on a transmission-line analogy. The experimental technique makes use of a non-reflecting terminal and a probe microphone for exploring the sound field on each side of the discontinuity. From the measurements the characteristic reflection and transmission factors and the equivalent impedance matrix are derived.

534.213.4 2278

The Measurement of Sound Reflection and Transmission at Right-Angled Bends in Rectangular Tubes.—W. K. R. Lippert. (*Acustica*, 1954, Vol. 4, No. 2, pp. 313–319.) Experimental equipment is described and results are discussed for symmetrical and asymmetrical discontinuities. The measurements agree well with the theory of Miles (*J. acoust. Soc. Amer.*, 1947, Vol. 19, p. 572) and prove that the phase relations of the characteristic factors which have been derived theoretically for loss-free cases are valid.

534.213.4 2279

On the Theory of Sound Reflection in an Open-Ended Cylindrical Tube.—H. Levine. (*J. acoust. Soc. Amer.*, March 1954, Vol. 26, No. 2, pp. 200–211.) Reflection coefficient R and end correction l are incorporated into a boundary-value formulation of the wave propagation problem. Two techniques are described for solving the integral equations involved: a variational procedure giving approximate results, and a method based on initial modification of an integral equation which yields exact values for R and l for a tube of circular cross-section. Results obtained by the two methods are compared.

534.232 2280

Suppression of Flexural Vibrations of Barium Titanate.—C. L. Darner. (*J. acoust. Soc. Amer.*, March 1954, Vol. 26, No. 2, pp. 256–257.) $BaTiO_3$ in thickness resonance develops an intense shear mode of vibration which sets up flexural waves and gives a directivity pattern with strong side lobes. The flexural waves are suppressed in a particular 1-Mc/s transducer by forming square $\lambda/2$ indentations along its edges.

534.232 : 537.228.1 2281

Characteristics of Radiating Variable-Resonant-Frequency Crystal Systems.—W. Welkowitz & W. J. Fry. (*J. acoust. Soc. Amer.*, March 1954, Vol. 26, No. 2, pp. 159–165.) One-dimensional theory of piezoelectric systems is applied to ADP and $BaTiO_3$ transducers with Hg backing, operating in water. Curves are presented

showing (*a*) power output as a function of frequency, (*b*) resonance-frequency shift as a function of backing length, and (*c*) bandwidth as a function of frequency. A system in which half the crystals have a natural resonance frequency twice that of the others can be operated over a continuous frequency range of about 5.3 : 1.

534.24-14 2282

On Nonspecular Reflection at a Rough Surface.—J. W. Miles. (*J. acoust. Soc. Amer.*, March 1954, Vol. 26, No. 2, pp. 191–199.) The reflection of a plane wave at a rough interface separating two fluid media is examined neglecting second-order terms in the magnitude of roughness. Exact solutions are obtained for the case of a sinusoidal boundary. For reflection of a pulse from a perfectly reflecting sinusoidal boundary, the boundary acts as a band-pass filter of the nonspecular components of the reflected wave; outside the pass-band, reflection is specular and distortionless. Analysis for a boundary not perfectly reflecting shows that the pass-band is independent of the properties of the reflecting medium.

534.321.9 2283

An Ultrasonic Double-Reflector Concentrator.—L. D. Rozenberg. (*C. R. Acad. Sci. U.R.S.S.*, 11th Aug. 1953, Vol. 91, No. 5, pp. 1091–1094. In Russian.) Theory and description of a system consisting of a paraboloid located inside a coaxial ellipsoid and having its focus coincident with one of the foci of the ellipsoid. A plane wave incident normally on the external surface of the paraboloid is concentrated at the second focal point of the ellipsoid. The geometrical conditions for velocity- and pressure-focusing are derived and shown graphically in system-parameter form. A similar system was described by Barone (603 of 1953).

534.321.9 : 534.2 2284

Conditions for obtaining the Greatest Concentration of Ultrasonic Radiation.—L. D. Rozenberg. (*C. R. Acad. Sci. U.R.S.S.*, 11th Feb. 1954, Vol. 94, No. 5, pp. 845–848. In Russian.) Theoretical investigation of focusing to obtain maximum pressure or maximum velocity at the focal point of (*a*) reflected or refracted plane waves, and (*b*) waves from curved radiators such as barium titanate or quartz. The variation of the focusing factor with the aperture is shown graphically for five different systems.

534.321.9 : 61 2285

Ultrasound and Medicine. A Survey of Experimental Studies.—J. F. Herrick & F. H. Krusen. (*J. acoust. Soc. Amer.*, March 1954, Vol. 26, No. 2, pp. 236–240; *Proc. nat. Electronics Conf., Chicago* 1953, Vol. 9, pp. 235–243.) A critical review of the applications of ultrasonics in therapy, diagnosis and biological measurements. 43 references.

534.321.9-14 : 534.6 2286

Measurements of Sound Absorption in Aqueous Salt Solutions by a Resonator Method.—O. B. Wilson, Jr, & R. W. Leonard. (*J. acoust. Soc. Amer.*, March 1954, Vol. 26, No. 2, pp. 223–226.) Measurements have been made in the frequency range 50–500 kc/s, using a modified reverberation technique. Results are presented for $MgSO_4$ solutions in particular, and for sea water.

534.6 : 534.321.9 : 537.228.1 2287

Very Small Ultrasonic Probes for Acoustic-Field Measurements in Liquids.—G. Bolz. (*Z. angew. Phys.*, Feb. 1954, Vol. 6, No. 2, pp. 54–59.) Theoretical and experimental investigation of the performance of piezoelectric probes small compared with wavelength. Suitable crystals have only one piezoelectric axis; the best is tourmaline; $BaTiO_3$ may also have advantages. The crystal is mounted on the tip of a thin wire making contact with its metallized face. Sensitivity increases with frequency and probe surface area, and is practically independent of direction when crystal dimensions are one eighth the wavelength in the liquid. A tourmaline probe for 1 Mc/s was capable of measuring acoustic powers as low as 5×10^{-3} W/cm².

534.612 : 534.321.9 : 535.314 2288

The Study of a Sound Field by means of Optical Refraction Effects.—J. Kolb & A. P. Loeber. (*J. acoust. Soc. Amer.*, March 1954, Vol. 26, No. 2, pp. 249–251.) The broadening of a slit image when a light beam traverses an ultrasonic field can be calculated by a method based on Wiener's theory of refraction of light in a liquid with refractive index varying continuously in one plane. The application of the principle for investigating pressure distribution in a stationary sound wave in the frequency range below 1 Mc/s is illustrated. A simple method of measuring wavelength is outlined.

534.614-14 : 534.321.9 2289

The Dispersion of the Velocity of Sound in Water between 500 and 1 500 kc/s.—T. K. McCubbin, Jr. (*J. acoust. Soc. Amer.*, March 1954, Vol. 26, No. 2, pp. 247–249.) Ultrasonic waves at 500 and 1 500 kc/s were transmitted simultaneously by a transducer in water at 26°C. Measurements were made of the change in relative phase between the two signals received by a second transducer at different distances from the first. The velocities at the two frequencies are equal to within 1 part in 290 000.

534.845 2290

Perforated Facing and Sound Absorption.—U. Ingard. (*J. acoust. Soc. Amer.*, March 1954, Vol. 26, No. 2, pp. 151–154.) An analytical study is made of the absorption characteristics of a porous layer with perforated facing. The latter contributes to the total impedance not only a mass reactance but also an additional acoustic resistance which may be larger than that of the porous layer itself. This obtains only when the porous material is in close contact with the facing, and is due to the near-field (higher-mode) losses in the porous material around the perforations. The effect on the absorption characteristics is considerable.

534.845 2291

Propagation, Interference, Reflection, Absorption, Diffusion of Acoustic and Ultrasonic Waves rendered Visible by the Schlieren Method.—F. Canac. (*Acustica*, 1954, Vol. 4, No. 2, pp. 320–328. In French.) A detailed description of the schlieren method and its application to the study of absorption and reflection of various materials. Reduced-scale models of coffered ceilings and other structures were also examined. Working frequencies were normally 10 and 23 kc/s, but 69 kc/s and 4 kc/s have also been used.

621.395.623.7 2292

Useful Absolute Efficiencies of Typical Loudspeaker Systems.—R. K. Vepa & N. K. Trivedi. (*Acustica*, 1954, Vol. 4, No. 2, pp. 329–332.) An objective criterion is proposed, called the 'useful absolute efficiency'. This is defined as the ratio of the acoustic power output, radiated in the forward direction and contained within a 100° cone, to the electrical power input from a matched resistive generator. Tests were made in the open air on three types of loudspeaker at 400, 1 000 and 3 000 c/s. Results are compared with computed axial efficiencies.

621.395.623.73 **2293**

Studies on the Cone-Type Loudspeakers: Part 4 — On the Effects of the Surrounding Device of the Cone-Type Dynamic Loudspeakers.—T. Nimura & K. Kido. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, March 1953, Vol. 4, No. 2, pp. 205–219.) The sound-pressure minima and cone-velocity maxima which occur in the 1–2-kc/s region of the frequency response of a circular conical loudspeaker are caused by the corrugated surround. By using an obliquely-cut circular cone or an elliptical cone, a nearly level frequency/pressure characteristic can be obtained over a wide frequency range. Part 3: 3328 of 1952 (Nimura & Matsui).

621.395.623.74 : 537.585 **2294**

Pressure Effects of Ionic Currents in Atmospheric Air with various Discharge Configurations.—Löb. (See 2365.)

621.395.625.3 **2295**

Magnetic Recording.—M. Camras. (*Proc. Instn Radio Engrs, Aust.*, March 1954, Vol. 15, No. 3, pp. 61–69; *Convention Record Inst. Radio Engrs*, 1953, Part 3, pp. 16–25.) Outline of principles and problems involved.

621.395.625.3 : 621.397.5 **2296**

A System for Recording and Reproducing Television Signals.—Olson, Houghton, Morgan, Zenel, Artzt, Woodward & Fischer. (See 2517.)

681.84/.85 **2297**

The Dynamic Restoring Forces on Gramophone Pick-ups.—W. Mühe. (*Funk u. Ton*, March 1954, Vol. 8, No. 3, pp. 147–162.) The factors investigated experimentally were: (*a*) effect of test-record groove characteristics on the restoring-force/frequency curve of various types of pickup, (*b*) the relation between restoring force and needle tracking, and (*c*) relation between restoring force and record wear. Both the C.C.I.R. and German standard test records were used. Results show that the restoring force for the majority of pickups was too high at low frequencies, causing poor tracking or even jumping the groove at high amplitudes. An optimum needle pressure therefore exists.

AERIALS AND TRANSMISSION LINES

621.315.212 : 621.3.018.75 **2298**

Reduction of the Distortion of Pulses transmitted by a Perfectly Uniform Coaxial Line by Frequency Translation.—R. Cazenave. (*Onde élect.*, Feb. 1954, Vol. 34, No. 323, pp. 147–152.) Analysis of the response of an ideal transmission line indicates the advantages of frequency translation for reducing amplitude and phase distortion, using a modulator and high-pass filter, with a phase-shift network for regrouping the transmitted frequencies at the receiving end. Unit-pulse response characteristics are compared for operation with and without the filtering and the phase-correction stages. A numerical calculation is made for transmission over 9 km of 2·6/9·4 coaxial cable with cut-off frequency 300 kc/s.

621.315.212(083.74) **2299**

Choice of the Correct Characteristic Impedance for High-Frequency Cables.—F. Gutzmann. (*Fernmeldetech. Z.*, March 1954, Vol. 7, No. 3, pp. 136–139.) In fixing a standard characteristic impedance for all h.f. cables, considerations of maximum voltage and maximum operating temperature are inconclusive. Attenuation is the only satisfactory criterion. The relation of characteristic impedance to cable dimensions for a prescribed maximum attenuation is discussed. Comparison of different cables shows that standardization to a value of 50 or 75Ω is impracticable. About 60Ω is the only possible value.

621.372.2 **2300**

Some Wave Properties of Helical Conductors.—J. H. Bryant. (*Elect. Commun.*, March 1954, Vol. 31, No. 1, pp. 50–56.) An analysis is made of the velocity of propagation and the relation between the longitudinal field and total power flow in systems comprising a helical line with inner and/or outer coaxial cylinders. Results are shown graphically as functions of frequency.

621.372.2 **2301**

An Experimental Investigation of the Properties of Corrugated Cylindrical Surface Waveguides.—H. E. M. Barlow & A. E. Karbowiak. (*Proc. Instn elect. Engrs*, Part III, May 1954, Vol. 101, No. 71, pp. 182–188.) Brass rods of $\frac{3}{16}$-in. outer diameter having shallow transverse external corrugations uniformly distributed along the length of the rod, were used to guide cylindrical surface waves at frequencies in the range 2·5–10 kMc/s. Provided there are more than two corrugations within the guide wavelength, higher-order surface waves are not present. The results of measurements of the surface reactance are shown graphically. An approximate expression for the surface reactance of a corrugated surface is derived which is in reasonable agreement with the experimental results, provided that the slot width is less than the slot depth, and that each wavelength includes several corrugations.

621.372.8 **2302**

Pass Band and Dispersion of Waveguides loaded with Circular Irises.—R. Combe. (*C. R. Acad. Sci., Paris*, 26th April 1954, Vol. 238, No. 17, pp. 1697–1699.) Approximate formulae are derived. Calculations are made of the permissible tolerances on the dimensions of the waveguide elements and on the frequency and temperature variations to obtain a value of λ_g within prescribed limits. Results are compared with those obtained experimentally for A1 guides for $\lambda = 10$ cm with a permissible variation of 1 mm. Application is particularly relevant to linear accelerators for electrons.

621.372.8 **2303**

The Dimensioning of Loaded Waveguides for the H_{10} Mode.—H. Weber. (*Telefunken Ztg*, March 1954, Vol. 27, No. 103, pp. 44–53.) Characteristic impedance, cut-off frequency and propagation constant are computed for an unloaded rectangular waveguide with and without losses, using an equivalent-circuit method. The results are extended to a waveguide loaded with a longitudinal undercut section, stray capacitance at the load edges being taken into account. Equations derived are plotted, and examples illustrate their application in determining the dimensions or characteristics of waveguides for specific purposes.

621.372.8 **2304**

Transmission Loss of the Waveguide having Thin Dielectric Film on its Inner Wall.—H. Uchida, Y. Mushiake & S. Nishida. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, March 1953, Vol. 4, No. 2, pp. 287–298.) Equations are derived for the approximate transmission losses of a rectangular waveguide for an H_{10} wave, and of a circular waveguide for E and H waves. The equations are valid only at frequencies which are not near the cut-off frequency. The calculated attenuation constant of a rectangular waveguide with an 0·01-cm layer of enamel is $\sim 9{\cdot}76 \times 10^{-3}$ db/m at 4 kMc/s, that of a circular waveguide is $\sim 3{\cdot}22 \times 10^{-3}$ db/m at 4 kMc/s for the E_{01} wave.

621.372.8 **2305**

A Reflectionless Waveguide Termination.—J. Smidt. (*Appl. sci. Res.*, 1954, Vol. B3, No. 6, pp. 465–476.) The characteristics of an *H*-plane *T*-junction provided with a movable short-circuiting plunger and a movable

dissipating element of arbitrary nature are discussed. A matrix-algebra method is used for calculating the coefficients determining the optimum positions of the plungers and the values of the reflection coefficients. Calculated and measured values for a termination for operation at about 9 kMc/s are in good agreement.

621.372.8 : 551.594.6 **2306**

Propagation of a Pulse in a Waveguide.—M. Cotte. (*Onde élect.*, Feb. 1954, Vol. 34, No. 323, pp. 143–146.) Analysis of the propagation of a disturbance which can be resolved into components of similar mode but different frequency (2447 of 1948) is extended to the case of a waveguide with walls of finite conductivity. Two cases are distinguished: (*a*) H_{0n} waves in which the wavefront corresponds approximately to a pulse delay proportional to the distance travelled; (*b*) E_{mn} or H_{pn} waves suffering in addition a dispersion increasing as the square of the distance; this dispersion is the same for all E_{mn} waves. Results relating to circular waveguides may have application to the propagation of atmospherics.

621.372.8 : 621.385.029.64 **2307**

Output Windows for Tunable Magnetrons.—T. S. Chen. (*Electronics*, May 1954, Vol. 27, No. 5, pp. 170–173.) Design data and nomograms are given for metal diaphragms with ceramic windows used for sealing the magnetron output waveguide and for coupling power to the transmission line. Both single-frame and double-frame (sandwich) types are discussed.

621.396.67 **2308**

The Impedance of an Antenna above a Circular Ground Plate Laid upon a Plane Earth.—G. Bekefi. (*Canad. J. Phys.*, March 1954, Vol. 32, No. 3, pp. 205–222.) Analysis given by Storer (586 of 1952) is extended to include the case when the system is laid upon an imperfectly conducting earth. The expression for the aerial impedance is stationary with respect to small variations about its true value of the unknown radial electric field over the surface of the earth. Numerical results are given for the case of a ground plate large compared with λ. The effect of variations of the dielectric constant of the earth is shown. Results are in satisfactory agreement with those obtained, using Monteath's theory (2648 of 1951). An alternative variational formula applicable to plates of smaller diameter gives the impedance in terms of radial currents flowing in the plate.

621.396.67 **2309**

The Theory of a Linear Antenna: Part 2.—Y. Nomura & T. Hatta. (*Technol. Rep. Tohoku Univ.*, 1953, Vol. 18, No. 1, pp. 90–104.) The directivity and receiving quality of the linear aerial are investigated by the method developed in part 1 (3201 of 1953). The radiation field round the transmitting aerial is calculated as the sum of partial fields due to Fourier components of the aerial current; the properties of the receiving aerial follow from those of the transmitting aerial. The radiation patterns of some asymmetrically fed aerials are shown. The method is similar to, but more general than, that of Hara (*Hochfrequenztechnik und Elektroakustik*, Dec. 1934, Vol. 44, No. 6, pp. 185–193.)

621.396.67 **2310**

Antenna-Scattering Measurements by Modulation of the Scatterer.—H. Scharfman & D. D. King. (*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, pp. 854–858.) A laboratory method is described in which scattering from an object under test is compared with that from a standard scatterer (e.g. a metal sphere) by mounting the two objects at opposite ends of a horizontal column mounted in turn on a rotating vertical shaft, and irradiating them alternately from a horn emitter. The horn is in one arm of a slightly unbalanced hybrid-T arrangement, and a fraction of the power scattered back to it is passed to the detector arm. Synchronous detection is used; because of the rotation of the objects, the phase of the back-scattered signal varies rapidly with respect to that of the local signal. Curves obtained for the back-scattering cross-section of dipoles with lengths of $0{\cdot}4\lambda$–$1{\cdot}6\lambda$ are in good agreement with theoretical and experimental curves obtained by other workers. The method is applicable over the frequency range from about 1 to 5 kMc/s.

621.396.67 : 621.372.21 **2311**

Losses in Parallel-Wire Lines.—J. Arsac, P. André & R. Zaccai. (*Onde élect.*, Feb. 1954, Vol. 34, No. 323, pp. 170–177.) With a view to the application of open-wire feeders for radio-astronomy aerial systems, calculations are made of ohmic and radiation losses in the frequency range 150–1 500 Mc/s. For 2-wire lines 500 wavelengths long, with conductors a wavelength apart, and neglecting height factors, non uniformities and oxidation effects, graphs are drawn showing total losses as a function of characteristic impedance for 4 wire diameters and 6 frequencies.

621.396.67 : 621.396.96 **2312**

General Theory of Plane-Wave Scattering from Finite, Conducting Obstacles with Application to the Two-Antenna Problems.—J. E. Storer & J. Sevick. (*J. appl. Phys.*, March 1954, Vol. 25, No. 3, pp. 369–376.) The variational techniques of Levine & Schwinger (1583 of 1952) are used to obtain approximate solutions for the free-space scattering by a number of finite, perfectly conducting obstacles whose interactions are explicitly accounted for. The result gives the far-zone scattered-field distribution in terms of the obstacle currents. Variational expressions are obtained for the total scattering and for the back-scattering cross-sections. The complete mathematical development for the problem of the back-scattering cross-section of two identical non-staggered unloaded aerials oriented parallel to the incident field is presented, and results for the case of broadside radiation for half-wave and full-wave aerials are shown graphically.

621.396.67.029.6 : 621.397.62 **2313**

Switch-Tuned U.H.F.-V.H.F. [indoor television receiving] **Antenna.**—G. Hills. (*Tele-Tech*, Jan. 1954, Vol. 13, No. 1, pp. 93..108.) A dipole 25 in. long with elements shaped from metal strips to form two cones attached to metal end caps is used. In the v.h.f. band the tuning adjustment matches the aerial to the 300-Ω input lead. For the u.h.f. band a correcting network compensates the series inductance and distributed capacitance of the standard selector switch used.

621.396.677.3 **2314**

The Principle and the Design of Yagi-Uda Antenna: Part 1.—S. Uda & Y. Mushiake. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, March 1953, Vol. 4, No. 2, pp. 299–312.) Using Hallén's theory (*Nova Acta Regiae Societatis Scientiarum Upsaliensis*, Series IV, No. 4, Vol. 11, 1938, pp. 3–44) for the current distribution in a linear aerial, the effective lengths of the transmitting and receiving aerials are calculated. Expressions for the self and mutual impedances of the elements and the input impedance of the aerial system are given and a general expression for the radiation characteristic is derived. The effective length factors of aerial elements are also shown graphically.

621.396.677.45 **2315**

Wide-Frequency-Range Tuned Helical Antennas and Circuits.—A. G. Kandoian & W. Sichak. (*Elect. Commun.*, March 1954, Vol. 31, No. 1, p. 49.) Correction to paper abstracted in 1304 of May.

621.396.677.85 **2316**

Reflection of Electromagnetic Waves at Metal-Plate Media.—G. Piefke. (*Arch. elekt. Übertragung*, March 1954, Vol. 8, No. 3, pp. 101–110.) A theoretical investigation is made of the transmission and reflection of a plane wave incident normally on a system of infinitely thin metal plates spaced a distance a apart and aligned parallel to the electric field. A detailed analysis is made for the wavelength range $1 < 2a/\lambda_0 < 2$, considering (*a*) a plane wave incident normally on the system, and (*b*) a TE_{10} wave proceeding from the medium into free space. Reflection coefficients are equal in magnitude in the two cases, but the phase angles are different. For the transmission coefficients conditions are reversed, the phase angles being equal and the magnitudes different. Phase-angle curves obtained are used to determine the thickness and position of a dielectric plate placed behind the system for no reflection to occur. See also 1879 of 1951 (Lengyel).

AUTOMATIC COMPUTERS

681.142 **2317**

Arrangement of Batteries and Relays permitting the Solution by Analogy of Nonlinear Partial Differential Equations by means of a Chain of Resistances and Capacitances.—A. Blanc. (*C. R. Acad. Sci., Paris*, 29th March 1954, Vol. 238, No. 13, pp. 1377–1378.)

681.142 **2318**

Scale Factors for Analog Computers.—J. B. Reswick. (*Product Engng*, March 1954, Vol. 25, No. 3, pp. 197–201.) Description of a design technique whereby scale factors relating analogue variables to the variables of the system investigated are first determined for true-time operation.

681.142 **2319**

A Time-Sharing Analog Multiplier.—H. Freeman & E. Parsons. (*Trans. Inst. Radio Engrs*, March 1954, Vol. EC-3, No. 1, pp. 11–17.) The circuit is based on the same principle as that of Broomall & Riebman (2546 of 1952). Accuracy to within 0·2% is achieved for a range of input voltages from 0 to 210 V when the comparator voltage lies between 0 and 75 V, depending on the circuit arrangements. 400 multiplications per second were made, indicating the suitability of the circuit for time-sharing techniques, but higher rates of operation seem possible.

681.142 **2320**

System Organization of the DYSEAC.—A. L. Leiner & S. N. Alexander. (*Trans. Inst. Radio Engrs*, March 1954, Vol. EC-3, No. 1, pp. 1–10.) DYSEAC is a general-purpose high-speed digital computer incorporating the following special facilities: (*a*) external-transfer operations concurrent with internal computing, such transfers referring directly to any area of the internal storage system; (*b*) adjustment of speed of internal programme so that it proceeds in step with the external programme; (*c*) interruption of a programme for interpolation of new orders.

681.142 **2321**

A Simple Analogue Divider.—J. L. Douce. (*Electronic Engng*, April 1954, Vol. 26, No. 314, pp. 155–156.) A circuit is described which provides an output voltage proportional to the ratio between two input voltages, a pulse of duration inversely proportional to one input being used to gate the other input. The results are accurate to within 5% over a wide range of inputs.

681.142 **2322**

An Operational-Digital Feedback Divider.—M. A. Meyer, B. M. Gordon & R. N. Nicola. (*Trans. Inst. Radio Engrs*, March 1954, Vol. EC-3, No. 1, pp. 17–20.) In this divider the input pulses operate directly on the output, the circuit forming a closed feedback loop in which the desired quotient corresponds to the only possible steady state. The accuracy of the system can be selected by using the appropriate number of significant digits from the eleven available.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.011.2/.3 **2323**

New High-Frequency Proximity-Effect Formula.—A. C. Sim. (*Elect. Commun.*, March 1954, Vol. 31, No. 1, pp. 63–66.) Reprint. See 2918 of 1953.

621.314.25 : 621.372 **2324**

An R.M.S.-Sensitive Phase-Shifting Circuit.—H. J. Fraser. (*Proc. Instn Radio Engrs, Aust.*, March 1954, Vol. 15, No. 3, pp. 59–60.) A circuit delivering an output whose phase depends on the r.m.s. value of the input uses a tungsten-filament diode as r.m.s. current detector. The diode is operated with 50-c/s voltage on the anode, and a voltage derived from the a.c. component of anode current is added to a fixed 50-c/s voltage to give the resultant variable-phase output. Applications for control purposes are mentioned.

621.314.632 + 621.314.7 **2325**

The Double-Base Diode: A Semiconductor Thyratron Analog.—Aldrich & Lesk. (See 2535.)

621.316.842.012.3 **2326**

A Nomograph to Facilitate the Design of Single Layer Resistance Windings.—R. S. Read & I. Mills. (*Instrum. Practice*, March 1954, Vol. 8, No. 3, pp. 215–217.)

621.316.86 : 537.312.6 **2327**

How to use Thermistors.—F. K. Bennett. (*Product Engng*, March & April 1954, Vol. 25, Nos. 3 & 4, pp. 182–185 & 200–204.) Review of thermistor characteristics and applications with tabulated data for rod, disk, washer and bead types.

621.316.86 : 621.396.822 **2328**

Current-Noise in Composition Resistors.—D. A. Bell & K. Y. Chong. (*Wireless Engr*, June 1954, Vol. 36, No. 6, pp. 142–144.) Because of the inherent inhomogeneity of the resistor material, and because the noise depends on the square of the current density, modifications of the resistor structure at a few points of high current density can have a large effect on the noise without greatly affecting the d.c. resistance. Experimental evidence in support of this view is given. The effect may account for the observed lack of correlation between noise and d.c. resistance with large currents. Measurements made on resistors of the same rating but different types indicate a relation between noise coefficient and shape factor.

621.318.57 **2329**

A New High-Speed Bistable Device for Pulse Sharpening.—Y. Druet. (*Onde élect.*, Feb. 1954, Vol. 34, No. 323, pp. 130–134.) Description of a triode-hexode flip-flop circuit (648 of 1953) generating 3×10^6 pulses/sec, and its application in switching and scaling circuits.

621.372 **2330**

***RLC* Canonic Forms.**—F. M. Reza. (*J. appl. Phys.*, March 1954, Vol. 25, No. 3, pp. 297–301.) A class of *RLC* networks is defined, which has canonic structure in the Foster sense. *LC* and *RL*-*RC* networks and networks with slight dissipation may belong to this class, in which case their analysis or synthesis is simplified. Examples of network synthesis illustrate the method.

621.372 **2331**

Bounds Existing on the Time and Frequency Responses of Various Types of Networks.—A. H. Zemanian. (*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, pp. 835–839.) Six theorems are presented relating the transient and steady-state responses of linear, stable, fixed, lumped-constant networks. Fourier-transform analysis is used. Physical interpretations are discussed, rise times and settling times being considered. The overshoot or undershoot of the response to a step-current input for a RC driving-point impedance cannot be $>100\%$.

621.372 **2332**

Corner Plots.—G. E. Anner. (*Radio & Telev. News, Radio-Electronic Engng Section*, March 1954, Vol. 51, No. 3, pp. 14–18, 26.) An approximation to the shape of the actual response curve for RL and RC circuits is obtained by suitable combinations of straight lines called corner plots. The parameters involved are defined, and rules for their determination by inspection of the circuit derived. The method is not restricted to impedances but may also be applied to network transfer functions, and is discussed in Bode's 'Network Analysis and Feedback Amplifier Design', Chapter XV.

621.372 : 512.831 **2333**

Matrix Analysis of Multiterminal Transducers.—J. Shekel. (*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, pp. 840–847.) The multiterminal transducer is defined as a network with a set of n input terminals and a set of n output terminals. It can be represented by its impedance, admittance or transfer matrix. Special properties of networks exhibiting symmetry and/or reciprocity are discussed. The representation is classed as definite or indefinite according as the voltage reference terminals are or are not specified. Simple networks can be analysed by inspection; more complicated networks may be treated as cascades of simple ones. The method is illustrated by deriving the transfer matrices of some simple networks, including a distributed-amplifier section.

621.372.413 **2334**

Natural Vibrations of an Open Cavity.—M. Jessel. (*C. R. Acad. Sci., Paris*, 15th March 1954, Vol. 238, No. 11, pp. 1205–1206.) The field is expressed in a manner taking account of a set of oscillation modes associated with the cavity openings.

621.372.413.012.3 **2335**

Cavity-Resonator Design Charts.—N. A. Spencer. (*Electronics*, May 1954, Vol. 27, No. 5, pp. 186–188.) Charts applicable to square-section and to circular-section cavities are given.

621.372.5 **2336**

A Generalization of Weissfloch's Transformation Law.—H. Lueg. (*Arch. elekt. Übertragung*, March 1954, Vol. 8, No. 3, pp. 137–141.) The transformation law relating to a loss-free quadripole between homogeneous lines is generalized by showing that all points on the transformation curve can be correlated with corresponding positions on the input and output lines between which the quadripole acts as an ideal transformer with a reactance in parallel. See also 992 of April.

621.372.5.015.3 : 621.376.3 **2337**

Transient Response in F.M.—I. Gumowski. (*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, pp. 819–822.) "The f.m. response to the unit impulse and the unit step function is calculated for a network whose transfer function is known. A meaning is assigned to the associated Fourier integrals, which diverge in the Riemann sense. The method is generalized to any input function which vanishes for negative t. As an illustration of the method the impulse and the step f.m. responses of a single tuned circuit are calculated."

621.372.54 : 621.315.212 **2338**

Filter using Coaxial Transmission Line as Elements.—H. B. Yin & T. U. Foley. (*RCA Rev.*, March 1954, Vol. 15, No. 1, pp. 62–74.) Exact equivalent circuits are presented for coaxial line elements with sleeve or undercut sections, taking account of capacitance or inductance effects at the discontinuities. From the corresponding equations the performance of filters comprising one or more of such elements can be predicted in terms of image impedance, cut-off frequency, attenuation and band limits. Measurements on a two-section low-pass filter confirm the theory.

621.372.54.029.62 **2339**

Variable U.S.W. Filters.—K. H. Krambeer & F. Künemund. (*Frequenz*, March 1954, Vol. 8, No. 3, pp. 65–77.) Results of an investigation of filters with distributed circuit elements and their equivalents with lumped L,C,R, indicate the circuits suitable for u.s.w. use. The filters described, which consist of adjustable cavity resonators and short lines, include separating filters for metre-band television and an adjacent-channel suppressor for transmitters and transmitter-receivers.

621.373.412 **2340**

Notes on a Cause of Frequency Instability of Partially Plated Piezoelectric Crystals (Proximity Effect).—W. J. 't Hart. (*Tijdschr. ned. Radiogenoot.*, March 1954, Vol. 19, No. 2, pp. 116–117. In English.) External field conditions may have a marked effect on the resonance frequency of partially plated crystals. Movement of an object close to the resonator may produce a relative frequency shift of the order of 10^{-6} or even 10^{-5}. As an extreme example, a shift of about 10 c/s was produced by hand effect in a 1-Mc/s AT-cut crystal of diameter 29 mm and electrode diameter 9 mm, the equivalent resistance simultaneously increasing by 10%. A qualitative explanation of the effect is given by reference to equivalent circuits.

621.373.421.1 **2341**

The Fluctuating Character of the Establishment of Oscillations in an Oscillator.—I. S. Gonorovski. (*C. R. Acad. Sci. U.R.S.S.*, 11th Feb. 1954, Vol. 94, No. 5, pp. 869–872. In Russian.) The build-up of oscillations in an LCR-oscillator by white-noise potential fluctuations is considered theoretically.

621.373.421.11 **2342**

A Wide-Band Oscillator using a Conical-Helix Tuning Inductor.—J. S. Chatterjee. (*Proc. Instn elect. Engrs*, Part III, May 1954, Vol. 101, No. 71, pp. 165–170.) Description of an oscillator working over a frequency range of 45 : 1 and using a single tank circuit between the grid and the anode of a triode. The tuning circuit consists of (*a*) a variable inductor formed by two conical helices connected at their apices by a large capacitor, and (*b*) two variable cylindrical capacitors. For the high-frequency end the leads connecting the coils to the grid and the anode are used as transmission lines, the main tuning circuit being automatically isolated. Methods of calculating the oscillation frequency in terms of the circuit parameters are described, simplifying assumptions being made. A description is given of the design and performance of an experimental model for the range 10–450 Mc/s.

621.373.52 : 621.314.7 **2343**

Internal Oscillations and Microwaves in Transistors.—Hollmann. (See 2540.)

621.374 : 621.314.7 **2344**

Transistors convert Sine Waves to Pulses.—R. E. McMahon, I. L. Lebow & R. H. Baker. (*Electronics*, May 1954, Vol. 27, No. 5, pp. 160–161.) A circuit using eight point-contact transistors to amplify, limit and differentiate a sine-wave input is described. The power-supply unit uses junction diodes. The frequency range is 10 c/s–200 kc/s, minimum input is 5 V, pulse output 35 V maximum, pulse rise time $<0{\cdot}05\,\mu$s, pulse width adjustable from 0·3 to 1 μs, and output impedance 300–400 Ω.

621.375.2.024 : 621.317.3 **2345**

A Mains-Supplied Indicating D.C. Amplifier with Linear Response.—W. Oesterlin & A. G. Braun. (*Arch. tech. Messen*, Feb. 1954, No. 217, pp. 41–44.) A 4-stage unit for use in conjunction with a piezoelectric transducer and a Duddell oscillograph for obtaining indicator diagrams is described. An electrometer valve is used as input to a first preamplifier stage, from which cable connection is made to the remaining amplifier stages and the oscillograph. Amplifier stability is good, and effects of valve aging not apparent.

621.375.4 **2346**

Some Circuit Considerations of the Transistor.—Y. Watanabe. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, March 1953, Vol. 4, No. 2, pp. 331–387.) A detailed discussion of the single-stage transistor amplifier and in particular of the "unity coupler" condition. Stability criteria are also discussed. Since four useful varieties of a single-stage amplifier exist, a two-stage amplifier can take 16 different forms. These are divided into four groups, (*a*) high power gain, (*b*) low terminating resistance, (*c*) high terminating resistance, and (*d*) bilateral type. The latter is an emitter-base-base-emitter circuit and is suitable for obtaining high gains.

621.376.332 **2347**

A Triode F.M. Discriminator.—I. G. Baxter. (*Electronic Engng*, April 1954, Vol. 26, No. 314, pp. 146–147.) The triode is arranged to operate as a gated rectifier, with the gating time, and hence the rectified output, dependent on the input frequency. A sine wave with the straight portion extending over about one radian can be used for the input waveform. For a particular circuit in which the rectified output should theoretically change by about 20 V for a frequency change of 1%, the measured change for this frequency difference was about 7·5 V. The output is proportional to input amplitude as well as to frequency.

621.396.6 **2348**

Minimizing Contact Potential in Apparatus Design.—E. C. J. Marsh. (*Electronic Engng*, April 1954, Vol. 26, No. 314, pp. 148–152.) Consideration is given particularly to the design of radio equipment required to function under adverse conditions such as exposure to humid or salt-laden atmosphere. A table reproduced from the Inter-Services document RCS/1000 gives the potentials of various metals in sea water against the saturated calomel electrode, as a guide to the choice of metal coatings; the latter may be applied by electroplating, spraying or hot dipping.

621.396.667 **2349**

Signal-Operated Tone Compensation.—E. C. Miller. (*Electronics*, May 1954, Vol. 27, No. 5, pp. 184–185.) A triode valve is used as variable element of a circuit which boosts amplifier response at both ends of the a.f. range to compensate for the reduced response of the ear; the amount of boost thus varies automatically with the input level.

GENERAL PHYSICS

535.42 : 538.566 **2350**

On Diffraction by a Strip.—A. Erdélyi & C. H. Papas. (*Proc. nat. Acad. Sci., Wash.*, Feb. 1954, Vol. 40, No. 2, pp. 128–132.) Limitations of the integral-equation and Fourier-Lamé methods of dealing with the problem of diffraction by a strip or slit are discussed. The variational technique of Levine & Schwinger (1583 of 1952) can be used to obtain an approximate value of the far-zone field in a form which is stationary with respect to small variations about its true value of the current induced in the strip. A calculation using this representation, and assuming as a rough approximation a uniform-density distribution of current in the strip, gives a good approximation to the value of the far-zone field. The scattering cross-section is then found by using the scattering theorem [1898 of 1950 (Papas)].

535.42 : 538.566 **2351**

Diffraction of Electromagnetic Waves, Radiated from an Arbitrarily Oriented Electric or Magnetic Dipole, at an Ideally Conducting Half-Plane.—Yu. V. Vandakurov. (*Zh. eksp. teor. Fiz.*, Jan. 1954, Vol. 26, No. 1, pp. 3–18.) The solving of this problem is simplified by writing Maxwell's equations in a general form, so as to include the case of a conducting medium with a finite permeability, and by including a magnetic current for reasons of symmetry. The equation $\Delta P + k^2 P = T$ is solved for different boundary conditions of P. In particular cases P represents components of the electric or magnetic fields or vector potentials, T is a function of position which is zero except in a small volume element surrounding the dipole, and $k^2 = (\epsilon\omega - 4\pi\sigma i)\mu\omega/c^2$ with the usual notation for the dielectric constant, angular frequency, electrical conductivity, permeability, velocity of light, and $\sqrt{-1}$. The solutions for various orientations of the dipole are given in the form of definite single integrals which can be evaluated.

537.122 : 539.23 **2352**

Energy Loss of Electrons in Passage through Thin Films.—L. Marton & L. B. Leder. (*Phys. Rev.*, 1st April 1954, Vol. 94, No. 1, pp. 203–204.) Energy-loss values of 30-keV electrons passing through thin evaporated films of 21 metals and insulators are tabulated. Reasonable agreement with calculations of Pines & Bohm (1021 of April) and Pines (1376 of May) is shown.

537.2 **2353**

The Field $\vec{E}$ and the Induction $\vec{D}$ of a Point Electric Charge in Space.—É. Durand. (*C. R. Acad. Sci., Paris*, 5th April 1954, Vol. 238, No. 14, pp. 1478–1480.)

537.311.1 **2354**

Solid State Electronics.—K. K. Darrow. (*Research, Lond.*, Jan.–April 1954, Vol. 7, Nos. 1–4, pp. 2–9, 46–53, 94–100 & 137–141.) A general account of the mechanism of electronic conduction in solids.

537.311.31 : 539.234 **2355**

Notes on the Comparison between the Study of an Imperfect Contact and Experimental Results on Thin Metal Films.—N. Nifontoff. (*C. R. Acad. Sci., Paris*, 15th March 1954, Vol. 238, No. 11, pp. 1200–1202.) Continuation of investigation of the conduction mechanism in thin films [3258 of 1953 (Nifontoff & Perrot)].

537.52 : 537.533 **2356**

Electron Ejection by Slow Positive Ions Incident on Flashed and Gas-Covered Metallic Surfaces.—J. H. Parker, Jr. (*Phys. Rev.*, 15th March 1954, Vol. 93, No. 6, pp. 1148–1156.)

537.52 : 537.533 **2357**

Liberation of Electrons by Positive-Ion Impact on the Cathode of a Pulsed Townsend Discharge Tube.—R. N. Varney. (*Phys. Rev.*, 15th March 1954, Vol. 93, No. 6, pp. 1156–1160.)

537.52 : 537.56 **2358**

Ionization Processes in the Electrical Breakdown of Gases.—F. L. Jones. (*Brit. J. appl. Phys.*, Feb. 1954, Vol. 5, No. 2, pp. 49–53.) A brief review.

537.525.6 : 537.562 **2359**

Diffusion Cooling of Electrons in Ionized Gases.—M. A. Biondi. (*Phys. Rev.*, 15th March 1954, Vol. 93, No. 6, pp. 1136–1140.) Measurements made during low-pressure Ne and Ar afterglows show a reduction in ambipolar diffusion coefficient characteristic of diffusion cooling which is not observed when He is present.

537.533.8 **2360**

The Mechanism of Secondary Electron Emission.—A. O. Barut. (*Phys. Rev.*, 1st March 1954, Vol. 93, No. 5, pp. 981–984.) A simple theory based on the constant energy loss per unit path length of primary electrons accounts quantitatively for the variation of secondary electron yield below its maximum value. The theory can be extended to include a Bethe-type energy loss at high primary energies. Relations between secondary electron emission and atomic structure are discussed. Secondary emission in insulators and semiconductors is also considered.

537.533.8 **2361**

Explanation of the Inaccuracy of Secondary-Electron Measurements.—O. Beer. (*Ann. Phys., Lpz.*, 15th Feb. 1954, Vol. 14, Nos. 3/5, pp. 201–214.) A recording arrangement used for the measurements is described. A variation of δ, the secondary-electron ratio, with beam density was observed in several metals. This variation is probably due to the formation of positive ions at the target. When this is taken into account, the secondary-electron velocity distribution is found to be independent of temperature in the range 200–500°C, contrary to several other published results.

537.533.8 **2362**

Threshold of Secondary Electron Emission of Nickel and Molybdenum.—A. R. Shul'man & E. I. Myakinin. (*C. R. Acad. Sci. U.R.S.S.*, 11th Aug. 1953, Vol. 91, No. 5, pp. 1075–1078. In Russian.) The threshold is defined as the minimum energy of primary electrons for which the number of slow secondary electrons differs from zero. Experimental results show that it is equal to the work function, within the limits of experimental error. The velocity distribution of secondary electrons (including reflected electrons) at various primary electron energies, and the effect of pre-treatment of Mo by heating at 2 500°K for a period up to 10 days, are discussed and the experimental results shown graphically.

537.533.8 **2363**

Effective Depth of Secondary-Electron Emission.—N. D. Morgulis & N. G. Nakhodkin. (*C. R. Acad. Sci. U.R.S.S.*, 21st Feb. 1954, Vol. 94, No. 6, pp. 1029–1032. In Russian.) An experimental investigation is reported. The principal conclusions are that the effective depth of secondary-electron emission is smaller in metals than in semiconductors, that it is independent of the primary-electron energy, and that there is no direct relation between the secondary-emission efficiency and the emission depth.

537.56 : 538.63 **2364**

Theory of Plasmas in the presence of a Constant Magnetic Field of Arbitrary Intensity superimposed on an Oscillating Electric Field.—R. Jancel & T. Kahan. (*C. R. Acad. Sci., Paris*, 1st March 1954, Vol. 238, No. 9, pp. 995–996.) Generalization of results obtained previously (2196 of July and back reference).

537.585 : 621.395.623.74 **2365**

Pressure Effects of Ionic Currents in Atmospheric Air with various Discharge Configurations.—E. Löb. (*Arch. elekt. Übertragung*, Feb. 1954, Vol. 8, No. 2, pp. 85–90.) The mechanical pressures produced by steady and modulated ion currents were investigated theoretically for parallel-plate, concentric-sphere, and concentric-cylinder electrode systems and experimentally for a point-and-plate system. The agreement between theoretical and experimental results is good. The investigation is of interest in relation to the ionic loudspeaker.

538.114 **2366**

A Refinement of the Pauling Theory of Ferromagnetism.—G. Felsenfeld. (*Proc. nat. Acad. Sci., Wash.*, March 1954, Vol. 40, No. 3, pp. 145–149.) The theory formulated by Pauling (3586 of 1953) is modified to take into account the nonuniform electron density in ferromagnetic crystals.

538.3 **2367**

Electrodynamics without Potentials.—L. Infeld & J. Plebanski. (*Proc. roy. Soc. A*, 9th March 1954, Vol. 222, No. 1149, pp. 224–227.) By means of a more general approach based on the e.m. field and not potential, field equations of a general type are derived. These contain the equations of Dirac's new theory of electrodynamics (1574 of 1952) as an important special case.

538.3 **2368**

Maxwell's Tensor.—S. Slansky. (*C. R. Acad. Sci., Paris*, 8th March 1954, Vol. 238, No. 10, pp. 1103–1104.) Without modifying the classical e.m. field equations it is possible to replace Maxwell's tensor by another which gives the same expression for the Lorentz force but a different and in some ways more satisfactory expression for the distribution of energy in the field.

538.56 : 537.525 **2369**

Self-excitation of Oscillations in a Gas Discharge at High Pressures.—M. E. Gertsenshtein. (*Zh. eksp. teor. Fiz.*, Jan. 1954, Vol. 26, No. 1, pp. 57–63.) The interaction of sound and electron waves in a gas-discharge plasma at pressures $\geqslant$ 100 mm Hg is considered theoretically. The possibility is shown of self-excitation of a definite range of frequencies. See also Zaitsev (2778 of 1952) for work at $\sim$ 1 mm Hg.

538.566 **2370**

Group Velocity.—P. Poincelot. (*C. R. Acad. Sci., Paris*, 22nd March 1954, Vol. 238, No. 12, pp. 1289–1291.) Continuation of previous work (3420 of 1952). Theory applicable to the ionosphere and to waveguides is given.

538.566 : 537.56 **2371**

The Excitation of Plasma Oscillations.—D. H. Looney & S. C. Brown. (*Phys. Rev.*, 1st March 1954, Vol. 93, No. 5, pp. 965–969.) A beam of high-energy electrons, injected into the plasma of a d.c. discharge from an auxiliary electron gun, excited oscillations in the plasma, the standing-wave patterns set up for varying values of electron-beam density and thickness of the ion space-charge sheath being investigated by a movable probe. Discontinuous changes in oscillation frequency occurred as either the electron density or the sheath thickness was varied, but the frequencies were in accordance with the Tonks-Langmuir relation and Wehner's transit-time relation (2875 of 1951) in both cases. The results confirm

that the mechanism of energy transfer involved is a v.m. process as suggested by Wehner, and indicate that the oscillation is a longitudinal pressure wave set up in the plasma electrons.

538.569.4 2372

Zeeman Effect and Line Breadth Studies of the Microwave Lines of Oxygen.—R. M. Hill & W. Gordy. (*Phys. Rev.*, 1st March 1954, Vol. 93, No. 5, pp. 1019–1022.) Experiments with applied fields < 100 gauss gave results in accordance with weak-field Zeeman theory. The two important mechanisms involved are rotational resonance interaction and quadrupole-quadrupole interaction.

538.569.4 2373

Absorption of U.H.F. Radio Waves in the Range 250–920 Mc/s by Substituted Benzenes: Part 3.—D. K. Ghosh. (*Indian J. Phys.*, June 1953, Vol. 27, No. 6, pp. 285–293.) Measurements have been made on chlorobenzene, bromobenzene, *o*-xylene and *m*-xylene at room and lower temperatures; the positions of absorption peaks are reported.

538.61 2374

Relations between Magneto-optical Phenomena in the Visible and Radio Regions of the Spectrum.—A. Kastler. (*C. R. Acad. Sci., Paris*, 1st March 1954, Vol. 238, No. 9, pp. 1007–1009.)

621.3.032.44 2375

The Distribution of Temperature along a Thin Rod Electrically Heated in Vacuo: Part 1 — Theoretical.—S. C. Jain & K. S. Krishnan. (*Proc. roy. Soc. A*, 9th March 1954, Vol. 222, No. 1149, pp. 167–180.) An integral expression derived for the temperature distribution can be expanded as a convergent power series. For evaluation two regions are defined: region A, in the middle of the rod, and region B, the portions outside A. In the A region temperature distribution is parabolic; in the B region it is practically the same as in the corresponding end region of an infinitely long rod. An analytical expression is obtained for the temperature at the centre of a rod as a function of its length. For a summary of the analysis see *Nature, Lond.*, 23rd Jan. 1954, Vol. 173, No. 4395, pp. 166–167.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.7/.8 : 621.396.822 2376

Antenna and Receiver Measurements by Solar and Cosmic Noise.—J. Aarons. (*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, pp. 810–815.) The sun and various intense cosmic sources of r.f. radiation which have been previously measured are used as calibration sources for determining aerial patterns and receiver sensitivities for radio-astronomy investigations. Practical procedure is outlined. Inaccuracies are involved in evaluating background radiation, contours and solar energy distribution, but the technique is sufficiently accurate for checking field instruments.

523.72 : 621.396.822 2377

Radio Evidence of the Ejection of Very Fast Particles from the Sun.—J. P. Wild, J. A. Roberts & J. D. Murray. (*Nature, Lond.*, 20th March 1954, Vol. 173, No. 4403, pp. 532–534.) Dynamic spectra of Type-III r.f. bursts (fast frequency drift, duration 5–10 sec) are discussed. The observations were made using a spectroscope with a frequency range 40–240 Mc/s. Harmonic pairs are commonly observed, as in the case of the longer duration Type-II bursts previously studied [391 of February (Wild et al)]; from a comparison of the profiles for the fundamental and the second harmonic it appears that a low-frequency cut-off process occurs in this case also. The observed properties of Type-III bursts can be accounted for by associating the frequency drift with motion of a disturbance such as a corpuscular stream travelling outwards through the solar atmosphere. Several possible mechanisms are considered.

523.72 + 523.8] : 621.396.822 : 061.3 2378

Washington Conference on Radio Astronomy — 1954.—(*J. geophys. Res.*, March 1954, Vol. 59, No. 1, pp. 149–201.) The aim of the conference was to present a comprehensive survey of the present state of work in the field, to examine some of the most critical problems, and to indicate possible future lines of research. Summaries of some of the papers are given. For a short report see *Science*, 30th April 1954, Vol. 119, No. 3096, pp. 588–591.

523.8 : 621.396.822 2379

Generation of Radio Noise by Cosmic Sources.—J. H. Piddington: F. Hoyle. (*Nature, Lond.*, 13th March 1954, Vol. 173, No. 4402, pp. 482–484.) Critical comment on 125 of January and author's reply.

523.852.2 : 621.396.822] : 523.165 2380

On the Nature of the Discrete Radio Sources.—R. Q. Twiss. (*Phil. Mag.*, March 1954, Vol. 45, No. 362, pp. 249–258.) Investigation of results of measurements of radio noise from a source in Cassiopeia shows that the noise may be due to interaction of cosmic ray electrons with the local magnetic field if the average value of the latter is of the order of 10^{-2} gauss. The r.f. power received should then vary at least as rapidly as $\nu^{5.2}$ below a critical frequency in the range 10–20 Mc/s.

550.372 2381

Effective Radio Ground-Conductivity Measurements in the United States.—R. S. Kirby, J. C. Harman, F. M. Capps & R. N. Jones. (*Nat. Bur. Stand. Circular*, No. 546, 26th Feb. 1954, 87 pp.) The results of ground-conductivity determinations made at 621 broadcasting stations, at frequencies between 540 kc/s and 1·6 Mc/s, are presented in a series of maps, more than 7 000 radials being shown. The degree of correlation between the effective conductivity and the nature of the surface soil is insufficient for purposes of prediction.

550.381 : 537.12 2382

Electron Inertia and Terrestrial Magnetism.—C. Darwin. (*Proc. roy. Soc. A*, 23rd March 1954, Vol. 222, No. 1151, pp. 471–476.) Analysis shows that electron-inertia effects make no appreciable contribution to the geomagnetic field.

550.384 2383

The Areal Distribution of Geomagnetic Activity as an Aeromagnetic Survey Problem near the Auroral Zone.—L. W. Morley. (*Trans. Amer. geophys. Union*, Dec. 1953, Vol. 34, No. 6, pp. 836–840.)

550.384 2384

On the Dynamo Theory of Geomagnetic Field Variations.—S. K. Chakrabarty & R. Pratap. (*J. geophys. Res.*, March 1954, Vol. 59, No. 1, pp. 1–14.) Chapman's expression for the current function is solved in the most general way, assuming that the main component in atmospheric oscillation is semidiurnal, and using the same conductivity function as Chapman. Tables of (*a*) coefficients of the current function, and (*b*) numerical equinoctial values of the coefficients deduced by the authors and by Chapman are given. The Sq variations of H and V are deduced and compared with the results of observations at Abinger and Alibag, and with Chapman's analysis. In these calculations, the phase of the atmospheric oscillations has been taken as 275°, and results compare well with observations.

550.384.4 2385

The Lunar Diurnal Variations of the Earth's Magnetic Field for All Elements at Amberley, N.Z., based on Five Years' Observations.—J. M. Bullen & C. H. Cummack. (*N.Z. J. Sci. Tech. B*, March 1954, Vol. 35, No. 5, pp. 371–377.)

550.385 2386

Very Long Sequences of Geomagnetic Activity and its Annual Variation.—B. N. Bhargava & A. M. Naqvi. (*Nature, Lond.*, 13th March 1954, Vol. 173, No. 4402, pp. 498–499.) A study was made of the recurrence tendency of geomagnetic activity for the period 1950–1953. Two long sequences of storms were identified, mainly associated with solar M regions. The mean recurrence period for each of the sequences was 27·05 days. Characteristic annual variation is attributed to the approach of the earth's projection on the solar disk towards the zones of maximum solar activity.

550.385 : 551.510.535 : 551.594.5 2387

Magnetic Storms, Aurorae, Ionosphere and Zodiacal Light.—E. O. Hulburt. (*Sci. Mon.*, Feb. 1954, Vol. 78, No. 2, pp. 100–109.) General account of observed phenomena and review of theories which have been advanced in attempts to explain them.

551.510.5 2388

Study of Atmospheric Ions in a Nonequilibrium System.—C. G. Stergis. (*J. geophys. Res.*, March 1954, Vol. 59, No. 1, pp. 63–66.) The variation with time of the concentration of small ions in the atmosphere in a nonequilibrium system has been determined theoretically and in two sets of experiments. If the atmosphere is relatively unpolluted, equilibrium conditions may not be restored after disturbance until a time of about 15 minutes has elapsed.

551.510.53 2389

The Dissociation of Oxygen in the High Atmosphere.—M. Nicolet & P. Mange. (*J. geophys. Res.*, March 1954, Vol. 59, No. 1, pp. 15–45.) The O_2-O transition region is investigated, using recent rocket data on atmospheric transmission of solar radiation in the spectral region of the Schumann-Runge continuum of O_2. Observational data can be represented by a complete mixing of the atmosphere which causes the vertical distribution of molecular oxygen to follow atmospheric scale height. Mixing and diffusing processes are responsible for a shift in the transition region to lower heights than given by photochemical equilibrium considerations, thus the transition region must be associated with the mesopause. Airglow, formation of ionosphere regions, and dissociation of nitrogen are briefly discussed in the light of this theory.

551.510.535 2390

Motion of the Storm-D Regions.—V. Agy. (*Nature, Lond.*, 6th March 1954, Vol. 173, No. 4401, pp. 445–446.) Results of an analysis at the National Bureau of Standards of ionosphere data from 17 stations for the four years 1949–1952 do not support Piggott's hypothesis of coherent motion of storm-D regions (1672 of 1953).

551.510.535 2391

Propagation of a Plane Aerodynamic Wave of Semi-diurnal Oscillation Period through a Plane Ionosphere in a Uniform Magnetic Field.—I. Lucas. (*Arch. elekt. Übertragung*, Feb. 1954, Vol. 8, No. 2, pp. 91–95.) Analysis is based on the momentum equation for the gas and the tensor equation of electric conduction derived earlier [2085 of July (Lucas & Schlüter)]. Frequency and wavelength correspond to the atmospheric oscillations caused by tidal effects of the sun and the moon. The solution indicates that e.m. damping of the atmospheric oscillations will occur at > 300 km height. The electrical conductivity in a horizontal and in a vertical magnetic field is expressed as a function of the neutral-gas density.

551.510.535 : 550.38 2392

Dynamo Theory of Geomagnetic Tides.—I. Lucas. (*Arch. elekt. Übertragung*, March 1954, Vol. 8, No. 3, pp. 123–131.) Plasma theory and results of earlier analysis [2085 of July (Lucas & Schlüter)] are applied in deriving a differential equation expressing height-integrated ionospheric current as a function of latitude. Taking account of Coriolis forces and assuming a velocity amplitude of 60 cm/s for tidal oscillations at E-layer height, the calculated magnitude of geomagnetic tides is in agreement with recorded data, in particular as regards the large tidal amplitudes at the magnetic equator. The theory is consistent with the assumption that the negative particles in the E layer are predominantly electrons rather than ions.

551.510.535 : 551.55 2393

Ionospheric Wind Analysis by Meteoric Echo Techniques.—L. A. Manning, A. M. Peterson & O. G. Villard, Jr. (*J. geophys. Res.*, March 1954, Vol. 59, No. 1, pp. 47–62.) The procedure for finding vector average wind (3052 of 1950) is shown to be unaffected by the presence of turbulent wind components. Expressions are derived for the r.m.s. values of the horizontal and vertical wind components. Sources of errors are discussed in detail.

551.510.535 : 551.55 : 550.384 2394

Winds in the Upper Atmosphere deduced from the Dynamo Theory of Geomagnetic Disturbance.—E. H. Vestine. (*J. geophys. Res.*, March 1954, Vol. 59, No. 1, pp. 93–128.) Simple dynamo theory of winds moving along and perpendicular to the geomagnetic field is developed, and various wind systems are discussed which might account for certain phases of magnetic storms. A possible wind system for the main phase of a magnetic storm shows some measure of agreement with diurnal atmospheric motions deduced from radio-star scintillations and auroral motions. The role of such wind systems in modifying the effective transverse conductivity of the ionosphere is uncertain. Both the flux of X rays producing ionization and the dynamo airflow in the E region are apparently the same on days of magnetic storms as on days prior to them.

551.510.535 : 551.594.5 : 550.384 2395

Correlation of Magnetic, Auroral, and Ionospheric Variations at Saskatoon: Part 2.—J. H. Meek. (*J. geophys. Res.*, March 1954, Vol. 59, No. 1, pp. 87–92.) "The relations between magnetic, auroral, and ionospheric observations are summarized with reference to the occurrence of positive and negative magnetic bays. Auroral light associated with positive bays occurs at a higher geomagnetic latitude than that associated with negative bays. The magnetic and auroral light variations are compared to Martyn's theory of the aurora. If the latter is accepted, the conclusion is reached (1) that most aurora is caused by positively charged particles, and (2) that the conditions described for the early phase actually exist throughout most of a disturbance." Part 1: 1768 of June.

551.510.535 : 621.396.11.029.5 2396

Some Results of Sweep-Frequency Investigation in the Low-Frequency Band.—J. M. Watts & J. N. Brown. (*J. geophys. Res.*, March 1954, Vol. 59, No. 1, pp. 71–86.) Frequency-sweep measurements in the range 50–1100 kc/s are reported. Day-time records show traces of three strata whose virtual heights are between 70 and 110 km, of which the lowest—not always observed—produces only

a weak echo, and one sometimes suggesting that scattering is taking place at randomly located clouds. Nighttime records show an intermediate layer between the E and F layers, which is erratic in appearance, but seems to have continuity with the daytime E layer during sunset. Traces characteristic of magneto-ionic splitting are exhibited for this intermediate layer. Polarization and virtual-height records for the F layer at night are shown and the effects of moderate ionosphere disturbances are demonstrated.

551.510.535 : [621.396.822 : 523.8 **2397**

Influence of the Ionosphere on the Reception of Galactic Radiation of Frequency 29·5 Mc/s.—É. J. Blum, J. F. Denisse & J. L. Steinberg. (*C. R. Acad. Sci., Paris*, 26th April 1954, Vol. 238, No. 17, pp. 1695–1697.) Analysis of continuous measurements recorded at Marcoussis from May 1949 to April 1950 indicates that galactic radiation at 29·5 Mc/s is attenuated by the ionosphere, the effect being due partly to the F_2 layer and partly to the D layer. The results agree qualitatively with those obtained by Mitra & Shain (1426 of May) using a frequency of 18·3 Mc/s.

551.578.1 : 621.396.96 **2398**

Errors inherent in the Radar Measurement of Rainfall at Attenuating Wavelengths.—Hitschfeld & Bordan. (See 2404.)

551.578.4 : 621.396.96 **2399**

Radar Evidence of a Generating Level for Snow.—Gunn, Langleben, Dennis & Power. (See 2405.)

551.594 : 621.396.11.029.62 **2400**

Atmospheric Electricity and Long-Distance Very-High-Frequency Scatter Transmissions.—Isted. (See 2497.)

551.594.13 **2401**

The Electrical Conductivity of the Atmosphere over the Pacific Ocean.—S. C. Coroniti & E. Heaton. (*Trans. Amer. geophys. Union*, Dec. 1953, Vol. 34, No. 6, pp. 833–835.) Conductivity measurements were made at altitudes of 3·8, 5·2 and 6·4 km and between geomagnetic latitudes of 22° and 45°N. The rate of production of ion pairs computed from the measurements agrees well with that computed from cosmic-ray data.

551.594.6 : 621.372.8 **2402**

Propagation of a Pulse in a Waveguide.—Cotte. (See 2306.)

LOCATION AND AIDS TO NAVIGATION

621.396.93 **2403**

Re-radiation from Resonant Ship's Aerials.—J. H. Moon. (*Marconi Rev.*, 2nd Quarter 1954, Vol. 17, No. 113, pp. 61–63.) Experiments show that it is not always necessary to isolate other aerials on board when operating the direction finder. An indication is given of the distances at which various types of aerial may be used at the same time as the direction finder without impairing its accuracy.

621.396.96 : 551.578.1 **2404**

Errors inherent in the Radar Measurement of Rainfall at Attenuating Wavelengths.—W. Hitschfeld & J. Bordan. (*J. Met.*, Feb. 1954, Vol. 11, No. 1, pp. 58–67.) An equation is derived giving rainfall rate at a given range in terms of received power level; this equation takes account of attenuation due to intervening rain, and includes a calibration constant expressing the radar performance. At attenuating wavelengths (3 cm and, to a lesser extent, 5·6 cm) a small error in this constant causes a large error in the result. Correcting for attenuation is therefore not recommended unless the calibration error can be held within very narrow limits.

621.396.96 : 551.578.4 **2405**

Radar Evidence of a Generating Level for Snow.—K. L. S. Gunn, M. P. Langleben, A. S. Dennis & B. A. Power. (*J. Met.*, Feb. 1954, Vol. 11, No. 1, pp. 20–26.) An analysis is presented of precipitation patterns obtained during the winter of 1951–1952 on an AN/TPS-10A radar at Montreal Airport. Trail patterns were observed on 19 out of 22 days; on 13 stable days well defined snow trails were detected.

621.396.96 : 621.396.67 **2406**

General Theory of Plane-Wave Scattering from Finite, Conducting Obstacles with Application to the Two-Antenna Problems.—Storer & Sevick. (See 2312.)

621.396.962.33 **2407**

The L.C.T. [Laboratoire Central de Télécommunications] **Radar Receiver with Elimination of Fixed-Target Echoes.**—H. Tanter. (*Onde élect.*, Feb. 1954, Vol. 34, No. 323, pp. 99–109.) Description of 10-cm phase-comparison pulse radar equipment. Two types are in production: a single receiver for mobile use and a 3-receiver unit for master stations. Theoretical sensitivity and practical performance in respect of range, fixed-target echo elimination and 'visibility' factor for moving targets are discussed.

621.396.963.3 **2408**

Information Cells on Intensity-Modulated C.R.T. Screens.—D. Levine. (*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, p. 853.) Correction to paper abstracted in 743 of March.

MATERIALS AND SUBSIDIARY TECHNIQUES

536.587 : 548.55 : 546.289 **2409**

Temperature Regulator used in Producing Germanium Crystals.—G. J. Lehmann & C. A. Meuleau. (*Elect. Commun.*, March 1954, Vol. 31, No. 1, pp. 19–26.) English version of paper abstracted in 1788 of June.

537.226 **2410**

Ferroelectricity and Crystal Structure: Part 2.—H. D. Megaw. (*Acta cryst., Camb.*, 10th Feb. 1954, Vol. 7, Part 2, pp. 187–194.) Part 2 of 1789 of June.

537.228.1 : 548.0 **2411**

Piezoelectric Crystals.—S. Kelly. (*Wireless World*, June & July 1954, Vol. 60, Nos. 6 & 7, pp. 275–280 & 345–348.) A survey of properties and applications. Two main classes are distinguished, for use (*a*) as resonators, (*b*) as transducers. Attention is devoted particularly to materials for gramophone pickups, viz., Rochelle salt, ADP and polycrystalline $BaTiO_3$.

537.311.33 **2412**

Intermetallic Semiconductors.—E. W. Saker & F. A. Cunnell. (*Research, Lond.*, March 1954, Vol. 7, No. 3, pp. 114–120.) A simple account is given of the various types of binding forces in solid elements and binary compounds or alloys. The characteristics of the compounds between the metals and the 'near-metals' of Groups IVB, VB, and VIB of the periodic table are discussed in terms of the binding forces. For transistor production, compounds from groups III and V have the important advantages of wider energy gaps than Ge and lower melting points than Si.

537.311.33 **2413**

Band Structure in Disordered Alloys and Impurity Semiconductors.—H. M. James & A. S. Ginzbarg. (*J. phys. Chem.*, Nov. 1953, Vol. 57, No. 8, pp. 840–847. Discussion, pp. 847–848.) The band structure is treated

by a method which involves counting the number of nodes in a solution of the wave equation with energy E as a means of determining how many states of the system have energies lower than E. An illustrative example shows how the sharply defined 'impurity band' of a crystal with regularly placed impurities is replaced by a broadened region of high energy-level density when the impurities are randomly arranged.

537.311.33 : 535.215 : 538.639 **2414**

Theory of the Photomagnetomechanical Effect.—P. Aigrain & O. Garreta. (*C. R. Acad. Sci., Paris*, 12th April 1954, Vol. 238, No. 15, pp. 1573–1575.) From theory previously given [2015 of 1953 (Aigrain & Bulliard)] it is predicted that even in a uniform magnetic field the currents produced in a semiconductor by illuminating its surface will give rise to a mechanical couple. The estimated value for a Ge cylinder of height 2 cm and diameter 0·5 cm, illuminated over a quarter of its surface at an intensity of 5×10^{17} photons/cm^2/s, is 0·25 dyne.cm for a field strength of 6 000 gauss.

537.311.33 : 535.37 **2415**

Luminescence of Carborundum Crystals on Passage of Current.—M. Schön. (*Z. Naturf.*, July 1953, Vol. 8a, No. 7, pp. 442–446.) The observed luminescence is attributed to the recombination of electrons and holes at lattice defects, the process being the inverse of that occurring in crystal phosphors. The energy diagram is established, and a formula is derived for the light yield. The relative importance of recombinations in the n, p and junction regions is examined. Luminescence intensity is proportional to current intensity for high values of the latter; there is a threshold value below which no luminescence occurs. The temperature dependence of this threshold, of the slope of the luminescence/current curve, and of the luminescence spectrum is discussed.

537.311.33 : 537.29 **2416**

Theory of the Effect of a Strong Field in Semiconductors.—A. I. Gubanov. (*Zh. tekh. Fiz.*, Feb. 1954, Vol. 24, No. 2, pp. 308–319.) A short survey including experimental and theoretical work published in Russia up to 1953. The thermoelectron and impact ionization mechanisms of the strong-field effect are considered and relevant formulae are given. Frenkel's thermoelectron-ionization theory is generalized to include the case of an exponential dependence of the electron energy on its distance from the centre binding the electron. The image forces occurring in the theory of solid rectifiers are calculated.

537.311.33 : [546.28 + 546.289 **2417**

Segregation of Impurities during the Growth of Germanium and Silicon Crystals.—R. N. Hall. (*J. phys. Chem.*, Nov. 1953, Vol. 57, No. 8, pp. 836–839. Discussion, p. 839.) "The segregation factors of impurities picked up by a growing crystal of germanium or silicon have been found to depend upon the growth rate and crystal orientation as well as upon the degree of stirring in the melt. This dependence is generally much greater for donor impurities than it is for acceptors and makes possible the growth of crystals containing large numbers of p-n junctions suitable for use in rectifiers and transistors. The assumption that impurity atoms are preferentially adsorbed at the surface of the crystal leads to an expression for the growth-rate variation which is consistent with the experimental results. Calculated impurity distributions are presented for a number of periodic growth cycles of practical interest."

537.311.33 : [546.28 + 546.289 **2418**

Piezoresistance Effect in Germanium and Silicon.—C. S. Smith. (*Phys. Rev.*, 1st April 1954, Vol. 94, No. 1, pp. 42–49.) The complete tensor piezoresistance has been determined experimentally for n- and p-type Si and Ge, and expressed in terms of the pressure coefficient of resistivity and two simple shear coefficients. One of the shear coefficients for each material is exceptionally large and cannot be explained in terms of known mechanisms. An electron transfer effect due to the structure of the energy bands in Si and Ge could account for this, but for p-type Ge an additional mechanism must be envisaged.

537.311.33 : [546.28 + 546.289 **2419**

Equilibrium Thermochemistry of Solid and Liquid Alloys of Germanium and of Silicon: Part 1—The Solubility of Ge and Si in Elements of Groups III, IV and V.—C. D. Thurmond. (*J. phys. Chem.*, Nov. 1953, Vol. 57, No. 8, pp. 827–830. Discussion, p. 830.)

537.311.33 : [546.28 + 546.289 **2420**

Equilibrium Thermochemistry of Solid and Liquid Alloys of Germanium and of Silicon: Part 2—The Retrograde Solid Solubilities of Sb in Ge, Cu in Ge, and Cu in Si.—C. D. Thurmond & J. D. Struthers. (*J. phys. Chem.*, Nov. 1953, Vol. 57, No. 8, pp. 831–834. Discussion, pp. 834–835.)

537.311.33 : 546.28 **2421**

Drift Mobilities in Semiconductors: Part 2 — Silicon.—M. B. Prince. (*Phys. Rev.*, 15th March 1954, Vol. 93, No. 6, pp. 1204–1206.) The drift mobilities of holes in n-type and of electrons in p-type material were measured for specimens with a range of resistivities from 0·3 to 30Ω.cm at 300°K. For single crystals of resistivity >10Ω.cm the mobility at 300°K of holes is $\mu_p = 500 \pm 50$ cm/s per V/cm and of electrons is $\mu_n = 1200 \pm 100$ cm/s per V/cm. The temperature dependence of mobility measured on two specimens of resistivity >10Ω.cm, is given by $\mu_n = 5{\cdot}5 \times 10^8 T^{-1.5}$ and $\mu_p = 2{\cdot}4 \times 10^8 T^{-2.3}$. Part 1: 1462 of May.

537.311.33 : 546.28 **2422**

Optical Investigations of Impurity Levels in Silicon.—E. Burstein, E. E. Bell, J. W. Davisson & M. Lax. (*J. phys. Chem.*, Nov. 1953, Vol. 57, No. 8, pp. 849–852. Discussion, p. 852.) Measurements were made on a number of p-type specimens, including boron-doped single crystals, over the range 2–38 μ. Ionization energies of impurities and excited states of the impurity atoms are reported.

537.311.33 : 546.289 **2423**

Directional Properties of the Cyclotron Resonance in Germanium.—B. Lax, H. J. Zeiger, R. N. Decker & E. S. Rosenblum. (*Phys. Rev.*, 15th March 1954, Vol. 93, No. 6, pp. 1418–1420.) Measurements were made at 8·895 kMc/s at 4·2°K on n- and p-type Ge. For n-type Ge the resonance-curve shape depends on sample orientation, but not on sample shape or size. Results can be explained by a conduction-band structure in which the energy surfaces consist of eight ellipsoids of revolution lying along the [111] axes.

537.311.33 : 546.289 **2424**

Changes of Surface Conductivity of Germanium with Ambient.—S. R. Morrison. (*J. phys. Chem.*, Nov. 1953, Vol. 57, No. 8, pp. 860–863. Discussion, p. 863.) The influence of the ambient medium on the conductivity and change in contact potential on illumination was investigated experimentally. The results are compared with those obtained by Brattain & Bardeen (1698 of 1953). The conductivity changes can be correlated with changes in a space-charge layer at the free surface of the semiconductor.

537.311.33 : 546.289 2425

Theory of the Galvanomagnetic Effects in *n*-Germanium.—S. Meiboom & B. Abeles. (*Phys. Rev.*, 1st March 1954, Vol. 93, No. 5, p. 1121.) Calculations of magnetoresistance coefficients, based on stated assumptions, agree very well with values measured at room temperature by Pearson & Suhl (166 of 1952), but agreement is less good with measurements made at 77°K.

537.311.33 : 546.289 2426

Infrared Absorption, Photoconductivity, and Impurity States in Germanium.—W. Kaiser & H. Y. Fan. (*Phys. Rev.*, 1st March 1954, Vol. 93, No. 5, pp. 977–980.) "Photoconductivity in gold-doped germanium at liquid nitrogen and liquid helium temperatures shows a long wavelength tail beyond the fundamental absorption edge, which falls off sharply at about 6 microns corresponding to 0·21 eV. This value agrees well with the acceptor activation energy determined by electrical measurements. For copper-doped germanium at low temperatures both absorption and photoconductivity show a maximum at about 22 microns corresponding to 0·055 eV. This value also agrees with the acceptor activation energy given by Hall effect measurements. At room temperature more absorption is found in the region 2 to 5 microns as compared to *p*-type germanium doped with indium and aluminum. This is likely to be due to photoionization from a deeper level 0·25 eV above the valence band."

537.311.33 : 546.289 2427

Experimental Evidence concerning Degeneracy in Germanium.—E. M. Conwell. (*Phys. Rev.*, 1st March 1954, Vol. 93, No. 5, p. 1118.) Comment on 1465 of May (Adams).

537.311.33 : 546.289 2428

Calculation of the Energy-Band Structures of the Diamond and Germanium Crystals by the Method of Orthogonalized Plane Waves.—F. Herman. (*Phys. Rev.*, 15th March 1954, Vol. 93, No. 6, pp. 1214–1225.)

537.311.33 : 546.289 2429

Effect of Nickel and Copper Impurities on the Recombination of Holes and Electrons in Germanium.—J. A. Burton, G. W. Hull, F. J. Morin & J. C. Severiens. (*J. phys. Chem.*, Nov. 1953, Vol. 57, No. 8, pp. 853–859. Discussion, p. 859.) "Nickel and copper impurities are found to increase the rate of recombination of holes and electrons in germanium single crystals. The measured dependence of lifetime on resistivity at room temperature is consistent with the Shockley-Read-Hall theory of recombination at traps near the middle of the forbidden band. The capture cross sections for holes and electrons have been estimated for these traps produced by nickel and copper. Additional evidence for such traps is also given by conductivity, Hall effect, photoconductivity and optical absorption measurements. Nickel or copper contaminations of the order of 10^{-10} atom fraction could account for the recombination rates observed in ordinary germanium crystals at room temperature."

537.311.33 : 546.289 2430

Diffusivity and Solubility of Copper in Germanium.—C. S. Fuller, J. D. Struthers, J. A. Ditzenberger & K. B. Wolfstirn. (*Phys. Rev.*, 15th March 1954, Vol. 93, No. 6, pp. 1182–1189.) Measurements were made in the temperature range 700°–900°C both by resistivity and radioactivity methods. The average diffusivity is $2{\cdot}8 \pm 0{\cdot}3 \times 10^{-5}$ cm²/sec and the solubility has a maximum at about 875°C of $4{\cdot}0 \times 10^{18}$ atoms of Cu per cm³. Results support the conclusion that one Cu atom contributes one conducting hole at room temperature. The thermal conversion effect in Ge is explained by a temperature-dependent solution and precipitation of Cu. Acceptor and diffusion properties of Cu in Ge are accounted for by decreased electron affinity of Cu at higher temperatures.

537.311.33 : 546.289 2431

Transmission of Electrons and Holes across a Twin Boundary in Germanium.—E. Billig & M. S. Ridout. (*Nature, Lond.*, 13th March 1954, Vol. 173, No. 4402, pp. 496–497.) The technique developed by Haynes & Shockley (2109 of 1949) for investigating the diffusion of minority carriers in an ambipolar semiconductor is used. A slice about 0·5 mm thick was cut from a single crystal of *n*-type Ge, with the twinning plane perpendicular to the surface. Graphs are presented of the variation of the signal picked up by a probe as its distance from an interrupted infrared illuminating spot is varied. The results indicate that twin boundaries do not impede the passage of electrons or holes to any appreciable extent.

537.311.33 : 546.561-31 2432

The Semiconductor Properties of Cu_2O: Part 8 — Electrical Conductivity at 0°C as Function of Position inside Specimen.—C. Fritzsche. (*Ann. Phys., Lpz.*, 15th Feb. 1954, Vol. 14, Nos. 3/5, pp. 135–140.) An increase of conductivity with distance from the surface of the sample was observed and was found to have been produced by the particular cooling process used in the preparation of the sample. The results are discussed. Part 7: 438 of February (Nieke).

537.311.33 : 546.723-31 2433

Electrical Properties of α-Fe_2O_3.—F. J. Morin. (*Phys. Rev.*, 15th March 1954, Vol. 93, No. 6, pp. 1195–1199.) Measurements reported in 1009 of 1952 are discussed. A theoretical model giving quantitative agreement with experimental data assumes conduction to involve only electrons and holes in the *d* levels of Fe ions. Another model giving qualitative fit assumes conduction in the *sp* bands of oxygen in addition.

537.311.33 : 546.74-31 2434

Electrical Properties of NiO.—F. J. Morin. (*Phys. Rev.*, 15th March 1954, Vol. 93, No. 6, pp. 1199–1204.) Measurements of the conductivity, Seebeck effect and optical transmission of NiO are reported and discussed on the basis of the two models suggested in 2433 above. NiO like αFe_2O_3 is an oxide with partially filled *d* levels, but with simpler characteristics. The first model gives quantitative agreement with experiment, the second does not.

537.311.33 : 546.812 : 539.231 2435

Transparent Semiconducting Oxide Films.—R. E. Aitchison. (*Aust. J. appl. Sci.*, March 1954, Vol. 5, No. 1, pp. 10–17.) Highly transparent tin oxide films with a surface resistance between 50 and 10 000Ω/square have been prepared by spraying a mixture of $SnCl_4$ and organic alcohol or acid on to heated glass. Pure SnO layers have a negative temperature coefficient of resistance; this is increased by addition of In_2O_3 and decreased by addition of Sb_2O_3. Measurements of transparency and resistance are reported; effects of impurities are discussed. Applications to electrical screening, electroluminescent panels, etc., are mentioned.

537.311.33 : 546.817.221 2436

Further Evidence of the Energy Gap of Lead Sulfide.—G. R. Mitchell & A. E. Goldberg. (*Phys. Rev.*, 15th March 1954, Vol. 93, No. 6, pp. 1421.) The wavelength dependence of the photovoltaic effect in a *p*-*n* junction in a synthetic single crystal indicates an energy gap of 0·4 eV, in agreement with measurements on the photoelectromagnetic effect in galena and the long-wavelength limit for thin films.

537.311.33 : 621.372.413 **2437**

A Resonant-Cavity Study of Semiconductors.—Hsi-Teh Hsieh, J. M. Goldey & S. C. Brown. (*J. appl. Phys.*, March 1954, Vol. 25, No. 3, pp. 302–307.) A solution of Maxwell's equations is obtained for a resonant cavity with an axial post of arbitrary electrical properties. This gives the dielectric coefficient and conductivity of the post in terms of the natural frequency and Q of the cavity. In the region of a particular value of conductivity, a relatively small change in conductivity gives rise to a transition from a cylindrical to a coaxial mode. The theory is particularly useful in the study of semiconductors.

537.311.33 : 621.396.822 **2438**

Noise in Semiconductors: Spectrum of a Two-Parameter Random Signal.—S. Machlup. (*J. appl. Phys.*, March 1954, Vol. 25, No. 3, pp. 341–343.) The spectrum is calculated of a random signal which may be in one of two states, where the mean lives σ and τ of the two states may be different. The form of the spectrum is the same as for the case of equal lives, the single parameter occurring in that case being replaced by $2[(1/\sigma) + (1/\tau)]^{-1}$. Application of the results to a consideration of noise in semiconductors shows that the assumption that trapping and releasing of carriers are uncorrelated processes is a good approximation provided the mean time during which a carrier is trapped is long compared with the mean time during which it is free to move. Hence trapping may be the process responsible for the current-dependent noise.

537.311.33 : 669-492.2 **2439**

The Electrical Conductance of Pressed Powders, in particular of Zinc Oxide.—J. C. M. Brentano & C. Goldberg. (*Phys. Rev.*, 1st April 1954, Vol. 94, No. 1, pp. 56–60.) Experiments are described, mainly on ZnO, in which the d.c. conductance of the powder pressed between parallel plates in an evacuated chamber is determined for different pressures and temperatures. A model based on the change of the energy gaps with pressure is developed which accounts for the phenomena observed. Transient changes of conductance with time are observed for which only tentative explanations are suggested.

538.221 **2440**

Variation of the Permeability of Irons and Steels as a Function of Mechanical Stresses.—J. Creusot. (*C. R. Acad. Sci., Paris*, 15th March 1954, Vol. 238, No. 11, pp. 1203–1205.) Curves representing $B = f(T)$, obtained from measurements of the induction B of specimens subjected to a constant magnetizing field and a variable tensile stress T, in some cases exhibit plateaux. The occurrence of these is related to the existence of the maximum-stability equilibrium state [1102 of April (Creusot & Langevin)] in the specimen.

538.221 : 538.67 **2441**

Magnetic Domains by the Longitudinal Kerr Effect.—C. A. Fowler, Jr, & E. M. Fryer. (*Phys. Rev.*, 1st April 1954, Vol. 94, No. 1, pp. 52–56.) Rotation of the polarization plane of obliquely incident light reflected from a polished SiFe single crystal revealed the antiparallel domains lying in the surface.

538.221 : 546.74 **2442**

Magnetic Behaviour of Thin Single-Crystal Nickel Films.—L. E. Collins & O. S. Heavens. (*Phil. Mag.*, March 1954, Vol. 45, No. 362, pp. 283–289.) The coercivity of monocrystalline Ni films grown epitaxially on the (100) face of rocksalt was studied as a function of thickness over the range 200–1 000 Å. The high coercivity characteristic of a single-domain structure was observed and the maximum value agrees approximately with that calculated from the anisotropy constants.

538.221 : [621.318.124 + 621.318.134 **2443**

Investigation of Paramagnetism of Some Ferrites.—F. Gal'perin, G. Dmitrakova & L. Molodtsova. (*C. R. Acad. Sci. U.R.S.S.*, 11th Feb. 1954, Vol. 94, No. 5, pp. 833–834. In Russian.) Results are given graphically of magnetic-susceptibility determinations for $MnO.Fe_2O_3$, $MgO.Fe_2O_3$ and $CoO.Fe_2O_3$, at temperatures between about 100° and 1 200° K.

538.221 : 621.318.13 **2444**

Dependence of the Coercivity of Magnetically Soft Materials on the Thickness of the Lamination.—V. A. Zaikova & Ya. S. Shur. (*C. R. Acad. Sci. U.R.S.S.*, 1st Feb. 1954, Vol. 94, No. 4, pp. 663–665. In Russian.) Experimental investigation of the coercivity of laminations of Fe, Ni, Fe-Ni alloys with 36–87% Ni, and Fe-Si alloys with 1–4% Si. In all cases but one, a critical thickness between 0·03 and 0·07 mm was found, below which the coercivity increases very rapidly. The results are shown graphically and are tabulated.

538.221 : 621.318.134 **2445**

Relaxation Phenomena of Irreversible Magnetization Processes in High-Permeability Ferrites.—T. Einsele. (*Z. angew. Phys.*, Feb. 1954, Vol. 6, No. 2, pp. 70–80.) Results of pulse measurements on ferroxcube IVB, siferrit and permenorm (1826 of June) are analysed. Relaxation phenomena of irreversible processes can be expressed by a simple power law. Determination of the relaxation time τ of reversible magnetization by a d.c. pulse technique is only possible under certain conditions. The magnetization of a ferrite with a linear rising branch to the static hysteresis loop can be resolved into reversible and irreversible components; in this case τ can be determined and conforms to results of a.c. measurements.

538.221 : 621.318.134 **2446**

Temperature Dependence of Ferromagnetic Resonance Line Width in a Nickel Iron Ferrite: a New Loss Mechanism.—J. K. Galt, W. A. Yager & F. R. Merritt. (*Phys. Rev.*, 1st March 1954, Vol. 93, No. 5, pp. 1119–1120.) The ferromagnetic-resonance line width for the [111] direction was measured on two single-crystal spheres of a Ni-Fe ferrite at 24 kMc/s over the temperature range 4°–400° K. Results for temperatures below room temperature suggest that a major cause of losses in many ferrites is the relaxation associated with crystallographic transitions characterized primarily by electronic rearrangements.

546.289 : 548.55 **2447**

Recrystallization of Germanium from Indium Solution.—J. I. Pankove. (*RCA Rev.*, March 1954, Vol. 15, No. 1, pp. 75–85.) A detailed description, illustrated with photographs, is given of the nature of the crystal growth obtained on cooling a Ge-in-In solution in contact with a Ge single crystal. The homogeneous recrystallized p-type region forms a single crystal with the original n-type seed. The p-n junction appears to coincide with the alloy front, the transition between the n and p regions being very abrupt. The recrystallized region is of very low resistivity.

546.561 : 535.215 **2448**

Negative Photoconductivity of Cuprite.—A. N. Krongauz & V. K. Lyapidevski. (*Zh. eksp. teor. Fiz.*, Jan. 1954, Vol. 26, No. 1, pp. 115–119.) The dependence of the photoconductivity on the voltage applied across the crystal and on the illumination intensity was investigated experimentally; the results are shown graphically. For every value of the illumination intensity there is a corresponding value of applied voltage above which the current variation due to the illumination changes from positive to negative. An explanation is

given in terms of the number of electrons in the conduction band. The theoretical formulae are in agreement with experimental results.

546.681 **2449**

Gallium Purification by Single Crystal Growth.—W. Zimmerman, III. (*Science*, 26th March 1954, Vol. 119, No. 3091, pp. 411–412.) High-purity Ga required for investigations of intermetallic compounds was obtained by the recrystallization method involving zone purification and single-crystal growth, using the Kryropoulos technique.

546.719 **2450**

Rhenium Metal — its Properties and Future.—L. W. Kates. (*Mater. & Meth.*, March 1954, Vol. 39, No. 3, pp. 88–91.) Rhenium is a ductile metal resembling Mn chemically and W physically. In the field of electronics it may prove useful for the manufacture of contacts, thermocouple alloys, cathodes and cathode heaters. Its resistivity at high temperature is greater than that of W, thus permitting use of more rugged filaments. Re is still relatively rare; it does not occur as a massive mineral but is found as a minor constituent in molybdenite, and can be recovered from flue dust from molybdenum-bearing copper ore.

621.315.612 **2451**

Reduction in the Loss Factor of Certain Ceramics by Heat Treatment.—H. Rawson. (*Nature, Lond.*, 6th March 1954, Vol. 173, No. 4401, p. 447.) Measurements of the dielectric constant and loss tangent of steatite, forsterite and other ceramics before and after treatment for 60 hr at 1 000°C are reported. It is suggested that this type of heat treatment will make possible the commercial production of ceramics with reduced losses.

621.315.612.6 : 537.226 **2452**

Dielectric Losses in Silicate Glasses.—V. A. Ioffe. (*Zh. tekh. Fiz.*, April 1954, Vol. 24, No. 4, pp. 611–621.) The temperature dependence of the loss angle was determined experimentally at 1 Mc/s in the range 12°–420°K for K_2O-, Na_2O-, PbO-, PbO-MgO-, Na_2O-K_2O-, and PbO-TiO_2-silicate glasses. Measurements were also made at 3×10^5 and 3×10^6 c/s. The relation between loss angle and composition at $8{\cdot}78 \times 10^9$ c/s and at room temperature was determined for the first three types of glasses. Results are shown graphically.

621.315.613.1 **2453**

Electrical Properties of Indian Mica: Part 5 — D.C. Resistivity.—S. S. Mandal & P. C. Mahanti. (*Indian J. Phys.*, June 1953, Vol. 27, No. 6, pp. 294–304.) Report of measurements of volume and surface resistivity of various qualities of red and green muscovite micas. The influence of humidity, temperature and pre-heating is investigated.

621.315.616.96 **2454**

Epoxy Resins.—R. A. Johnson. (*Electronic Engng*, April 1954, Vol. 26, No. 314, pp. 136–142.) A survey of the properties and applications of araldite casting resins, covering Type B and the more recently developed Types D, F, 33/896 (flexible), 33/912 (expanded) and 33/915 (impregnating).

666.3 : 621.791.3 **2455**

Ceramic-Metal Seals of the Tungsten-Iron Type.—D. G. Burnside. (*RCA Rev.*, March 1954, Vol. 15, No. 1, pp. 46–61.) Ceramic-to-metal sealing processes used in valve manufacture are briefly reviewed and desirable properties of the ceramics and sealing metals are indicated. A method is described for obtaining a firmly adherent bonding layer on the ceramic surface by brushing or spraying on a mixture of W and Fe powders and firing in a reducing atmosphere.

669.15.71 **2456**

16-Percent Aluminum-Iron Alloy Cold Rolled in the Order-Disorder Temperature Range.—J. F. Nachman & W. J. Buehler. (*J. appl. Phys.*, March 1954, Vol. 25, No. 3, pp. 307–313.) Cold rolling at 575°C of hot-rolled material gave an alloy of highly fibred structure having good resistance to oxidation and good magnetic properties.

MATHEMATICS

519.272.119 **2457**

Estimation of Correlation Coefficients from Scatter Diagrams.—G. R. Sugar. (*J. appl. Phys.*, March 1954, Vol. 25, No. 3, pp. 354–357.)

517.63(083.5) **2458**

Tables of Coefficients for the Numerical Calculation of Laplace Transforms. (Book Review)—H. E. Salzer. Publishers: United States Department of Commerce, Washington, 1953, 36 pp., 25 cents. (*Beama J.*, March 1954, Vol. 61, No. 201, p. 96.) "A very useful set of tables for those working in the field of transient and nonlinear phenomena."

MEASUREMENTS AND TEST GEAR

621.317 : 621.383.2 **2459**

The Photodianode: Investigation of the Total Current and of the Differential Current in an Asymmetrical Arrangement.—Deloffre, Pierre & Roig. (See 2543.)

621.317.3 : 621.315.212 **2460**

Coaxial Radio-Frequency Connectors and their Electrical Quality.—M. C. Selby, E. C. Wolzien & R. M. Jickling. (*J. Res. nat. Bur. Stand.*, March 1954, Vol. 52, No. 3, pp. 121–132.) Errors due to connectors used in impedance measurements made by the slotted-line technique are discussed. A definition is given of the connector as a component part of a connecting transformer which is completed by a supplementary line section; when the connecting transformer is short-circuited at either end a voltage node appears at the other end. The quality of the connectors is indicated by the transformation corrections needed to obtain accurate termination admittances. Node-shift methods are described for finding these corrections for various types of connector. Typical measurement results are presented for frequencies from 100 to 900 Mc/s. The technique is also useful for determining the quality of lines.

621.317.3.029.3(083.74) **2461**

I.R.E. Standards on American Recommended Practice for Volume Measurements of Electrical Speech and Program Waves, 1953.—(*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, pp. 815–817.) Standard 53 I.R.E. 3S2.

621.317.328.029.62 : 621.396.67 **2462**

An Experimental Field-Strength Meter for Band III.—G. T. Clack. (*J. Telev. Soc.*, Jan./March 1954, Vol. 7, No. 5, pp. 205–210.) A detailed description, with component values, is given of the circuit of a receiver for measurements of aerial gain and directivity at frequencies from 170 to 220 Mc/s. Input sockets are provided for 80-Ω and 300-Ω termination. The design provides for interchangeable tuning units for different bands. An i.f. of 34 Mc/s is used. Field tests with several types of aerial are reported, and the effect on the polar diagram of varying the spacing and length of a parasitic element is illustrated.

621.317.34.018.75 : 621.315.212 **2463**

Equipment for Measuring the Elongation of a Short-Duration Signal.—J. Bendayan. (*Onde élect.*, Feb. 1954, Vol. 34, No. 323, pp. 153–162.) Elongation of a pulse trace due to double reflection is used to assess the overall effect of cable discontinuities. Two sets of equipment for recording this elongation are described. For long cables a direct measurement is made of the pulse 'tail' at the remote end of the cable. For cables less than about 500 m in length an echo technique is used in which two sets of pulses with different repetition rates are transmitted along the cable, which is terminated by an equalizer.

621.317.343.018.75 : 621.315.2 **2464**

New Developments in Pulse Technique for Cable Testing.—J. Oudin. (*Onde élect.*, Feb. 1954, Vol. 34, No. 323, pp. 163–169.) The improvement in sensitivity of an echo meter attained by operating at suitably high gain with a system of amplitude and phase correction is limited ultimately, if a c.r. tube is used, by imperfections of vision. To maintain a fine trace and extend the range of fault location, integration techniques are necessary. The principles of (*a*) a delay-line system and (*b*) an auxiliary-pulse system with mechanical recording of the echo trace are described.

621.317.4 : 621.385.833 **2465**

Electron-Optical Shadow Method of Magnetic-Field Mapping.—L. Marton, J. A. Simpson & S. H. Lachenbruch. (*J. Res. nat. Bur. Stand.*, Feb. 1954, Vol. 52, No. 2, pp. 97–104.) Modifications of the method described by Marton & Lachenbruch (1211 of 1950) are indicated. Iterative analysis procedures are illustrated by the mapping of an otherwise inaccessible ferromagnetic domain field.

621.317.4 : 621.395.625.3 **2466**

Magnetic Recording Tape.—H. G. M. Spratt. (*Wireless World*, June 1954, Vol. 60, No. 6, pp. 264–267.) An arrangement for measuring the coercivity and remanence of recording tape is described. A large-size radio-receiver mains transformer is modified by providing a large air gap in the centre limb. Two search coils arranged in series opposition are placed in the gap and the tape sample is threaded through one of them. The differential voltage obtained, proportional to dB/dt, is applied to the Y-plate amplifier of a c.r.o. while a voltage proportional to H is applied to the X-plate amplifier. By including an integrating circuit in front of the Y-plate amplifier the B/H curve can be displayed.

621.317.411.029.64 **2467**

Measurement of Ferromagnetic Permeability at Microwave Frequencies.—G. S. Sanyal & J. S. Chatterjee. (*Indian J. Phys.*, June 1953, Vol. 27, No. 6, pp. 328–339.) The method uses a cylindrical cavity of nonmagnetic material with a detachable end plate. Resonance frequency and Q are measured first with the nonmagnetic end plate in position and then with a plate of the test material substituted. Relevant theory is given, the set-up is described, and results are reported for nickel and soft iron.

621.317.45 **2468**

Nondestructive Sensing of Magnetic Cores.—D. A. Buck & W. I. Frank. (*Elect. Engng, N.Y.*, Feb. 1954, Vol. 73, No. 2, p. 110.) Digest of paper published in *Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, pp. 822–830. The sense of the remanent magnetic flux in a core of the type used in digital-computer storage devices is detected by applying a small pulsed quadrature field to the core, thus rotating the field vector momentarily. This change of flux induces in a sensing coil wound on the core a voltage pulse whose sign depends on that of the remanent flux.

621.317.7 **2469**

The Application of Counter-Rotating Fields to Electrical Measuring and Indicating Devices.—R. L. Russell & N. W. Hodges. (*Proc. Instn elect. Engrs*, Part II, April 1954, Vol. 101, No. 80, pp. 178–182.) Two oppositely rotating magnetic fields which may or may not be of the same magnitude and frequency are combined to produce a resultant field of zero or low angular velocity, with which the moving element aligns itself. Various e.s. and e.m. applications of this principle are discussed.

621.317.7.025.001.4 **2470**

Alternating-Current-Instrument Testing Equipment.—A. H. M. Arnold. (*Proc. Instn elect. Engrs*, Part II, April 1954, Vol. 101, No. 80, pp. 121–131. Discussion, pp. 131–133.) An account is given of the equipment and methods used at the National Physical Laboratory for calibrating a.c. indicating instruments by comparison with standard meters.

621.317.71 **2471**

Voltage Transformer for Current Measurement.—A. Lutz & G. Poklekowski. (*Fernmeldetech. Z.*, March 1954, Vol. 7, No. 3, pp. 105–110.) A valve voltmeter circuit is described for measurement of current in circuits at high potential with respect to earth. The effect of the valve circuit on the current to be measured and the leakage current from the high-potential circuit through the valve are compensated by (*a*) a four-terminal network in the grid circuit, or (*b*) a suitable cathode resistor automatically biasing the valve. Details of a practical circuit are given in which both methods of compensation are applied. This operates in the frequency range 30 c/s–1 Mc/s over the current range 0·01–100 mA with power consumption 0·4 μW–4 mW and error $<3\%$. It compares favourably with thermocouple and rectifier-bridge instruments.

621.317.715 : 621.383.4 **2472**

Photoelectric Measurement of the Displacement of a Luminous Spot.—A. Thulin. (*C. R. Acad. Sci., Paris*, 15th March 1954, Vol. 238, No. 11, pp. 1210–1212.) The system uses a differential photoconductive cell arrangement to obtain a current proportional to the displacement of the spot, and is stabilized against fluctuations of illumination and sensitivity.

621.317.738 **2473**

Two Probe-Type Capacitance Meters.—L. Medina. (*J. Brit. Instn Radio Engrs*, May 1954, Vol. 14, No. 5, pp. 233–236.) Reprint. See 215 of January.

621.317.75 **2474**

A Spectrum Analyser for the Range 100 c/s to 100 000 c/s.—K. R. McLachlan (*J. Brit. Instn Radio Engrs*, May 1954, Vol. 14, No. 5, pp. 217-229.) "The specification is given of an analyser to measure the spectral distribution of the noise emanating from an air jet, and several methods of performing this analysis are discussed. The development of a practical instrument is described which uses a variable-frequency selective amplifier with a Wien bridge as the frequency-dependent feedback network, and some details of its performance are given. Errors due to the short time available for analysis are derived and some of the less familiar aspects of the circuits used, such as a symmetrical-to-asymmetrical convertor, are analysed."

621.317.761 + 621.373.421.13 **2475**

A Quartz-Crystal-Controlled Frequency Meter and Master Oscillator of High Accuracy.—E. Kettel. (*Telefunken Ztg*, March 1954, Vol. 27, No. 103, pp. 27–31.) Frequency meter Type FM 312/1 comprises a frequency

analysing unit of heterodyne type, a variable-frequency oscillator with frequency regulated by the analysing unit, and a standard-frequency generator. The frequency error is $\pm 1 \times 10^{-7} \pm 0{\cdot}2$ c/s between 1 kc/s and 3 Mc/s. The range is 1 kc/s–300 Mc/s when the instrument is used as a frequency meter, and 1–32 Mc/s for use as a master oscillator. Parasitic oscillation is 80 db below desired oscillation level. The standard-frequency generator is a 100-kc/s quartz crystal enclosed in a double thermostat. Provision is made for comparison with an external frequency standard.

621.372.8.001.4 : 621.396.96 **2476**

A Hybrid-Ring Method of Simulating Higher Powers than are available in Waveguides.—L. Young. (*Proc. Instn elect. Engrs*, Part III, May 1954, Vol. 101, No. 171, pp. 189–190.) A radar waveguide component must be tested at powers higher than those nominally available from the magnetron generator, since operating conditions render a safety margin of 50–100% or more necessary. The component is inserted in one arm of a hybrid ring in front of the plunger and the standing wave pattern is moved across the component, a second plunger maintaining a nonreflecting load to the magnetron. The effective power is then twice that of the magnetron. The method of connecting n such hybrid rings, giving a power multiplication of 2^n, is explained. It cannot be used to test high-power loads or any component that absorbs or radiates power.

621.385.029.6.001.4 **2477**

Magnetron Stability Tester.—H. S. Bennett & A. A. Kiriloff. (*Tele-Tech*, March 1954, Vol. 13, No. 3, pp. 96–97 . . 167.) The main sections of the tester are (*a*) radar power supply and modulator, (*b*) measurement apparatus for valve current, voltage and magnetic field, and (*c*) slotted line and dummy terminal line with associated measurement gear. Different kinds of magnetron may be tested over different frequency bands, and all factors involved in stability of operation can be determined.

621.396.822.029.65 : 537.54 **2478**

A Gas-Discharge Noise Source for Eight-Millimeter Waves.—T. J. Bridges. (*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, pp. 818–819.) Noise sources of a type previously described [e.g. 185 of 1952 (Johnson & Deremer)] are adapted for operation at 8 mm λ by reducing the dimensions of the gas tube and increasing the pressure. Measured noise levels of tubes with neon and argon fillings are 18·2 db and 15·9 db respectively above room-temperature levels. These figures are in good agreement with values calculated from gas-discharge theory.

621.397.62.001.4 **2479**

Measurements on Television Receivers: Part 2 — Measurement of Transmission Characteristics of Television Receiver Circuits.—O. Macek. (*Arch. tech. Messen*, Feb. 1954, No. 217, pp. 29–30.) The factors which are important in estimating performance of the r.f. and demodulation stages, and the suitability of square waves for testing delay characteristics are discussed. Part 1: 2397 of 1953.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

536.53 : 621.396.822 **2480**

Measurement of the Absolute Temperature of a Metallic Conductor based on the Voltage produced by Thermal Agitation of the Electrons in the Conductor.—R. Aumont, J. Romand & B. Vodar. (*C. R. Acad. Sci., Paris*, 22nd March 1954, Vol. 238, No. 12, pp. 1293–1296.) Results obtained with a modified form of the arrangement described by Garrison & Lawson (947 of 1950) are reported. Determinations are accurate to within about 1° at temperatures up to 780°K.

621.317.083.7 **2481**

Optical System for the Transmission of Information.—G. Cortellessa & R. Querzoli. (*Nuovo Cim.*, 1st March 1954, Vol. 11, No. 3, pp. 321–322.) Brief description of a telemetering system using a light beam modulated at a frequency which depends on the magnitude measured.

621.383.2 : 621.386 **2482**

Possibilities and Limitations of Image Intensification.—E. Fenner & O. Schott. (*Z. angew. Phys.*, Feb. 1954, Vol. 6, No. 2, pp. 88–95.) The limit set by fundamental brightness fluctuations of a point image is defined. Electron-optical image converters, television pick-up tubes and scanning systems for X-ray image intensification are described and their performances assessed. 46 references.

621.384.6 : 621.311.6 **2483**

An R.F. Generator for Nuclear Energy Studies.—L. Kornblith, Jr. (*Electronics*, May 1954, Vol. 27, No. 5, pp. 142–145.) Description of the power-supply equipment for the 450-MeV synchrocyclotron at Chicago. A 40-kW frequency-sweep oscillator is tuned between 18·2 and 28·4 Mc/s by means of a motor-driven capacitor. The output is pulsed so as to use only the descending part of the frequency sweep; the pulsing is performed by means of a photocell circuit actuated from mirrors on the capacitor shaft.

621.384.612 **2484**

Orbital Instabilities due to the Coupling between Radial and Vertical Oscillations in the Cosmotron.—J. Seiden. (*C. R. Acad. Sci., Paris*, 1st March 1954, Vol. 238, No. 9, pp. 1010–1012.)

621.384.612 **2485**

Space-Charge Forces in Strong-Focusing Synchrotrons.—S. E. Barden. (*Phys. Rev.*, 15th March 1954, Vol. 93, No. 6, pp. 1378–1380.) Relatively small changes in the average field gradient produced by space-charge effects may, when the number of magnet sectors is $\geqslant 10$, create conditions favourable to forced resonances due to imperfections in magnet alignment. This places strict limitations on the admissible space-charge forces, more particularly in the case of beams of heavy particles.

621.384.622.1 **2486**

Linear Accelerator for Electrons, with Preliminary Bunching.—M. Papoular. (*C. R. Acad. Sci., Paris*, 8th March 1954, Vol. 238, No. 10, pp. 1115–1117.) Use of the preliminary bunching device described with a 1-MeV accelerator gave an increase of 100% in the number of electrons attaining this energy, without adversely affecting the spectral distribution of energy.

621.385.833 **2487**

Notes on Chromatic Aberration of Electron Lenses.—H. Grümm. (*Ann. Phys., Lpz.*, 15th Feb. 1954, Vol. 14, Nos. 3/5, pp. 193–200.) Formulae for determining the chromatic aberration are derived using wave-mechanics theory of electron optics. The possibility of correcting the aberration in the case of a bell-shaped magnetic field is shown.

621.385.833 **2488**

Calculation of the Axial Potential in a Three-Electrode Electrostatic Lens.—P. Ehinger. (*C. R. Acad. Sci., Paris*, 22nd March 1954, Vol. 238, No. 12, pp. 1306–1308.) The

three-electrode lens with thick middle electrode is treated by applying the method previously developed for a two-cylinder lens (1877 of June) to the two halves of the system.

621.385.833 **2489**

A Simple Stigmator for Magnetic Electron Lenses.—S. Leisegang. (*Optik, Stuttgart*, 1954, Vol. 11, No. 2, pp. 49–60.) Asymmetry is compensated by means of iron inserts in the pole pieces. Axial astigmatism can be reduced to about 0·1 μ, and a resolving power of 1 μ can be attained.

621.387.424 **2490**

Operating Characteristics of Counters with External Cathode and Pure Methyl-Alcohol Filling.—D. Blanc. (*Nuovo Cim.*, 1st March 1954, Vol. 11, No. 3, pp. 231–240. In French.)

621.387.424 **2491**

Response of a Pulsed Geiger Tube.—H. B. Rosenstock. (*J. appl. Phys.*, March 1954, Vol. 25, No. 3, pp. 275–282.) The advantage of operating with pulsed rather than steady voltages on the tube is that higher radiation intensities can be measured; but if the duration of the pulse is comparable to the spread time of the discharge, the output-current/radiation-intensity relation will be nonlinear, since the resulting current surge may not reach its maximum before the end of the pulse. Using probability considerations, this relation is calculated as a function of the response of the tube under ordinary operating conditions. If the discharge initially spreads rapidly, an approximate general relation not involving the spread mechanism can be established. The response to be expected in two types of tube is discussed in detail.

PROPAGATION OF WAVES

621.396.11 **2492**

Ground-Wave Propagation at Ultrahigh Frequencies.—(*Nature, Lond.*, 27th March 1954, Vol. 173, No. 4404, pp. 573–574.) Two papers presented at the I.E.E. are summarized. The first, by Saxton & Harden, gave results of an experimental investigation of the effects of irregular terrain on ground-wave propagation at frequencies of 102·6 and 593·6 Mc/s. The second, by Saxton, compared results of such investigations with the corresponding conditions for transmission over a smooth earth, for propagation at frequencies between 50 and 800 Mc/s.

621.396.11 **2493**

Ionospheric Propagation.—R. Gea Sacasa. (*Rev. Telecomunicación, Madrid*, March 1954, Vol. 10, No. 35, pp. 24–32. In Spanish and English.) Report and comment on U.S. document 224 presented at the C.C.I.R. conference, London, 1953, discussing certain optimum-working-frequency and m.u.f. predictions for 1950 and 1951. See also 1773 of 1953.

621.396.11 : 535.42 **2494**

On the Theory of Diffraction of Electric Waves by Many Parallel Screens.—Y. Nomura. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, March 1953, Vol. 4, No. 2, pp. 231–248.) Expressions are derived for the intensity of a wave diffracted by two parallel screens, representing two mountain ranges, and the results are extended to the case of more than two parallel screens. The wave arriving by the shortest path, i.e. suffering the smallest number of diffractions, accounts for the major part of the resulting intensity. The effect of the image aerial is also considered.

621.396.11 : 551.510.535 **2495**

A Note on Sweep-Frequency Backscatter Observations.—R. Silberstein. (*J. geophys. Res.*, March 1954, Vol. 59, No. 1, pp. 138–139.) A typical range/frequency record obtained with improved equipment is shown, and the identification of backscatter sources of particular echoes briefly discussed.

621.396.11 : 621.317.353.3 : 550.38 **2496**

Influence of the Earth's Magnetic Field on the Interaction of Radio Waves in the Ionosphere.—I. M. Vilenski. (*Zh. eksp. teor. Fiz.*, Jan. 1954, Vol. 26, No. 1, pp. 42–56.) The discussion of the Luxemburg effect and cross-modulation (3095 of 1953) is extended to take account of the earth's magnetic field. A formula for the depth of cross-modulation is derived in terms of functions of the transmitter frequencies, the effective number of electron collisions and the gyromagnetic frequency. Calculations show that values of cross-modulation depths obtained by Cutolo (2617 of 1950) and Shaw (1472 of 1951) can be reconciled if the E layer is assumed to have been lower by 5–10 km in the former than in the latter experiments. The formulae apply to night-time conditions only.

621.396.11.029.62 : 551.594 **2497**

Atmospheric Electricity and Long-Distance Very-High-Frequency Scatter Transmissions.—G. A. Isted. (*Marconi Rev.*, 2nd Quarter 1954, Vol. 17, No. 113, pp. 37–60.) During an investigation of long-distance transmissions in the frequency band 30–100 Mc/s, it was observed that signals transmitted over distances of 500 km or more arrived at the receiver in a series of bursts, many of which were grouped in trains. At the same time, electrical discharges from clouds were observed, often having the same time arrangement as the signal bursts. Theory is developed to explain how these discharges, though occurring in the lower atmosphere, can give rise to pockets of intense ionization in the E region. The theory indicates that ordinary clouds, rather than storm clouds, are the main generators maintaining the fine-weather vertical potential gradient. It is also suggested that when energy is transferred from discharging clouds to fine-weather areas, continuous partial ionization of the E-region conduction path is set up, and in extreme cases may result in the formation of sporadic E; and that this partial ionization together with the ionization bursts is mainly responsible for very-long-distance transmission in the v.h.f. band. For a brief account see *Wireless World*, July 1954, Vol. 60, No. 7, pp. 343–344.

621.396.81 : 621.396.65 **2498**

Reliability of U.S.W. Radio Link extending far beyond the Horizon.—H. J. Fründt. (*Telefunken Ztg*, March 1954, Vol. 27, No. 103, pp. 41–43.) Field-strength recordings made at the Berlin end of a Berlin-Harz 60-Mc/s f.m. link are analysed. According as atmospheric refraction effect is or is not taken into account, the computed field strength is equalled or exceeded for 85% or 99·5% of the time respectively. This fact is of interest in planning. Signal/noise ratio in the individual channels is an important factor in reliability of operation; computation shows that some 14·5 db of noise is due to electrical apparatus and machines in the Berlin area. Over the period of a year, causes of service interruptions and their durations in percentage of time were (*a*) fading, 1·62%, (*b*) equipment failure, 3·37%, (*c*) transmission-line and cable connections, 5·82%, (*d*) other causes, 1·69%.

621.396.812.3 **2499**

Prolonged Space-Wave Fadeouts at 1046 Mc/s Observed in Cheyenne Mountain Propagation Program.—B. R. Bean. (*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, pp. 848–853.) The transmitter used in these propagation tests is located on the sheer face of the

mountain, at a height of about 2 800 ft. Receiving sites at three different distances are used, all with standard dipoles 43 ft above the surrounding plains. Records obtained during the first year of continuous operation exhibit prolonged fades, often more than 20 db below the monthly mean level and lasting from one minute up to several hours. Their occurrence coincides with widespread superrefraction as evidenced by enhanced signals beyond the radio horizon and ground modification of the refractive-index profile. The results emphasize the need to provide sufficient transmitter power when planning u.h.f. radio links with high-altitude transmitters and low-altitude receivers.

RECEPTION

621.396.621 **2500**

Radio Receiver Installations for Telegraphy and Single-Sideband Telephony in the Overseas Service. Developmental Principles and Practical Experience.—K. Fischer, W. Vesper & G. Vogt. (*Telefunken Ztg*, March 1954, Vol. 27, No. 103, pp. 14–26.) The development of Type EST 110 Kw/1 receiving equipment for telephony, and Type EST 111 Kw/1 for telegraphy is described and the technical problems involved are discussed. The equipment consists basically of a double-superheterodyne receiver with variable first i.f. and first local oscillator crystal-controlled. Frequency accuracy to within ± 2 kc/s at 30 Mc/s is achieved for ambient temperatures between 15° and 25°C and mains supply variations $< 10\%$. Special demodulation circuits to deal with standard types of wave, and a.f.c. and a.v.c. are provided. Each installation comprises at least two receivers, so that diversity operation is possible.

621.396.621 : 621.376.3 **2501**

Mobile F.M. Broadcast Receiver Design.—K. Onder. (*Electronics*, May 1954, Vol. 27, No. 5, pp. 130–133.) Distortion due to multipath transmission is reduced by making the limiter and discriminator bandwidth much greater than normal [734 of 1950 (Arguimbau & Granlund)]. An experimental receiver designed on this principle was tested in a car; the results indicated that ignition interference was also eliminated.

621.396.82 : 621.376.33 **2502**

Interference in Non-idealized F.M. Receivers.—H. Marko. (*Arch. elekt. Übertragung*, March 1954, Vol. 8, No. 3, pp. 111–122.) The effect of imperfect demodulator performance on the level of unintelligible interference, crosstalk and noise is analysed. Limiter, discriminator and detector characteristics are examined and design requirements for interference suppression in each stage are discussed.

STATIONS AND COMMUNICATION SYSTEMS

621.376.3 : 621.3.018.78 : 621.372.5 **2503**

Harmonic Distortion of Frequency-Modulated Waves by Linear Networks.—R. G. Medhurst. (*Proc. Instn elect. Engrs*, Part III, May 1954, Vol. 101, No. 71, pp. 171–181.) The expression connecting the distortion of the modulating signal with the distortion of the r.f. spectrum when a f.m. carrier is passed through a linear network is used to obtain the harmonic distortion when the modulating signal is a single tone. It is assumed that departures of the phase characteristic of the network from linearity, and of the amplitude characteristic from constancy, are small. Tables of functions involved in calculating distortion by this method are provided and comparison is made with the result obtained by van der Pol (2310 of 1946) and with some measurements.

621.376.5 **2504**

Gaussian Pulses.—J. P. Vasseur. (*Onde élect.*, Feb. 1954, Vol. 34, No. 323, pp. 139–142.) See 1905 of June.

621.376.56 **2505**

Transmission of Information by Integration of Coded Signals.—H. Harmuth. (*Arch. elekt. Übertragung*, March 1954, Vol. 8, No. 3, pp. 132–136.) The need for transmitting information regarding the position of individual pulses in a p.c.m. system is eliminated if decoding is effected by suitable integrations of a pulse group. For a given channel capacity the transmitted power required is only 3 db above the theoretically required value, compared with 9 db for a pulse-amplitude detecting system. A system based on performing three integrations of a five-unit pulse group to give all but two of the 32 possible pulse sequences is outlined. The maximum possible error due to a pulse being missed can be reduced by using a suitable alphabetic code.

621.394.13 **2506**

Code Convertors for the Interconnection of Morse and Teleprinter Systems.—R. O. Carter & L. K. Wheeler. (*Proc. Instn elect. Engrs*, Part III, May 1954, Vol. 101, No. 71, pp. 151–157. Discussion, pp. 158–164.) Automatic converters for the two directions of conversion and with Morse perforated-tape storage are described.

621.394.14 **2507**

Telegraph Codes and Code Convertors.—T. Hayton, C. J. Hughes & R. L. Saunders. (*Proc. Instn elect. Engrs*, Part III, May 1954, Vol. 101, No. 71, pp. 137–150. Discussion, pp. 158–164.) Codes in use for submarine cable and radio circuits are reviewed from the point of view of their traffic-carrying capacity and freedom from undetectable errors. The effects of distortion and of particular methods of working on the error rate, and methods of eliminating errors are discussed. A 7-unit/5-unit electronic converter and a 5-unit/7-unit mechanical converter are described.

621.394.7 + 621.395.7 **2508**

Unit Construction Practice (UCP) applied to Line-Transmission Equipment.—K. W. Harrison. (*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, pp. 822–829.) By standardizing a small number of functional units a flexible method of designing complete carrier-transmission equipments is provided. Bulk is reduced by efficient use of mounting space rather than by special miniaturization techniques.

621.396.41 : 621.374.5 **2509**

Electrical Delay Networks for Time Selection in Multichannel Systems.—H. Härtl & F. Rumpel. (*Fernmeldetech. Z.*, March 1954, Vol. 7, No. 3, pp. 118–122.) The design and construction of a lumped-element delay network is described. Design is based on the properties of an m-derived filter section. A unit comprises 125 similar sections, coils being assembled coaxially on the same former. Overall delay is 125 μs and upper cut-off frequency about 400 kc/s. Operating characteristics are discussed.

621.396.61 + 621.396.62 **2510**

A New Mobile Phase-Modulated Transmitter-Receiver Unit.—J. Anderson & W. D. Meewezen. (*Proc. Instn Radio Engrs, Aust.*, Feb. 1954, Vol. 15, No. 2, pp. 31–42.) The transmitter crystal oscillator circuit is noncritical in component values and has low a.f. distortion. An a.f. amplifier-limiter circuit prevents overloading of the oscillator. The frequency multiplication factor from crystal to aerial is 48. Power output is 24 W at 170 Mc/s, and the units for the 70–85-Mc/s and 156–170-Mc/s bands

differ only in the tuning circuits. Conversion from 6·3-V to 12·6-V operation is simple, and the same transmitter will give the higher output required from a base station transmitter if used with an a.c. h.v. supply unit. The double-superheterodyne receiver units for the two bands are identical apart from the r.f. and first mixer stages.

621.396.65 : 621.396.81 **2511**

Reliability of U.S.W. Radio Link extending far beyond the Horizon.—Fründt. (See 2498.)

621.396.933 **2512**

A Single-Sideband Controlled-Carrier System for Aircraft Communication.—G. W. Barnes. (*Proc. Instn elect. Engrs*, Part III, May 1954, Vol. 101, No. 71, pp. 121–130. Discussion, pp. 130–135.) A transmission system is proposed in which the carrier amplitude is made to vary inversely as the sideband amplitude. This system provides a.f.c. over a wider range than is usual and avoids the use of a very narrow carrier filter. A four-phase balanced modulator is used. The outphasing method of sideband rejection is applied in the receiver, which is provided with automatic carrier-frequency control using an electromechanical system with a memory for operation on the intermittent-carrier systems. Flight trials with experimental equipment are reported.

SUBSIDIARY APPARATUS

621.3.013.783 **2513**

Shielding Nomograph.—J. F. Sodaro. (*Electronics*, May 1954, Vol. 27, No. 5, p. 190.)

621.311.69 : 621.362 **2514**

Thermoelectric Generator TGK-3.—V. Daniel'-Bek, A. Voronin & N. Roginskaya. (*Radio, Moscow*, Feb. 1954, No. 2, pp. 24–26.) Description of a paraffin-lamp-driven generator for use with battery-type receivers. The outputs are 2 V, 2 A for the vibrator h.t. unit and 2 V, 0·5 A for heaters. A 1·2-V, 0·36-A tapping is also provided. Semiconductor-type thermoelements are mentioned as being more efficient than pure-metal thermocouples.

TELEVISION AND PHOTOTELEGRAPHY

621.397.2 : 621.3.018.78 **2515**

The Distortion of Television Signals by Attenuation and Phase Distortion in the Transmission System.—F. Bath & H. Kaden. (*Arch. elekt. Übertragung*, Feb. 1954, Vol. 8, No. 2, pp. 55–68.) Analysis shows that for satisfactory transmission of a black/white edge the demands on the video-signal transmission system are more exacting than for satisfactory transmission of a picture element. The conditions satisfying these demands are introduced in the coefficients of the Fourier expansions of the expressions for attenuation and phase distortion of the system. Tolerance curves for the permissible distortion, as function of frequency, are deduced from statistical considerations of distortion in the sections of the transmission system.

621.397.5 : 535.623 **2516**

Colour Television on 405 Lines.—(*Wireless World*, June 1954, Vol. 60, No. 6, pp. 256–257.) Account of a demonstration given in London, on a closed circuit. Comparison was made between a system with colour subcarrier inside the monochrome channel and one with the colour channel outside the monochrome channel. Better colour pictures were obtained with the latter system, but because of the extra bandwidth required use of this system in Bands I and III would involve overlap between the monochrome signal of one channel and the colour signal of the adjacent channel. A camera with only two pickup tubes was used for live scenes, one tube producing a normal-definition monochrome signal and the other producing two low-definition colour signals. For another account see *Elect. J.*, 14th May 1954, Vol. 152, No. 20, p. 1601.

621.397.5 : 621.395.625.3 **2517**

A System for Recording and Reproducing Television Signals.—H. F. Olson, W. D. Houghton, A. R. Morgan, J. Zenel, M. Artzt, J. G. Woodward & J. T. Fischer. (*RCA Rev.*, March 1954, Vol. 15, No. 1, pp. 3–17.) Details are given of a magnetic-tape system. For monochrome television ¼-in. tape is used, carrying one track for the video signal and one for the sound. For colour television ½-in. tape is used carrying five tracks, for the red, green, blue, synchronization and sound signals. A servomechanism is used to provide the required constancy of tape speed. This speed is 30 ft/s with the equipment described, and the width of the available frequency band is >3 Mc/s. The audio signals are modulated on to a 150-kc/s carrier for recording. Demonstrations of the system given at Princeton in December 1953 are briefly reported.

621.397.61 **2518**

Low-Level-Modulation Vision Transmitters, with Special Reference to the Kirk O'Shotts and Wenvoe Stations.—E. McP. Leyton, E. A. Nind & W. S. Percival. (*Proc. Instn elect. Engrs*, Part III, May 1954, Vol. 101, No. 71, pp. 190–191.) Discussion on 274 of January.

621.397.611.2 **2519**

Vidicon Film-Reproduction Cameras.—H. N. Kozanowski. (*J. Soc. Mot. Pict. Telev. Engrs*, Feb. 1954, Vol. 62, No. 2, pp. 153–162.) The advantages of the vidicon pickup tube for televising film are discussed, and a description is given of a complete camera unit, including deflection, video and control circuits. Equipment is under development for enabling transparent or opaque stills to be interspersed with films.

621.397.62 **2520**

Choice of a Television-Receiver Intermediate Frequency to suit the C.C.I.R. Standard.—W. Holm & W. Werner. (*Funk u. Ton*, March 1954, Vol. 8, No. 3, pp. 129–138.) Considerations of interference by other services, various transmitter harmonics, etc., show that the optimum European television sound i.f. is 33·4 Mc/s and vision i.f. 38·9 Mc/s. The use of these frequencies may require precautions against second-harmonic interference in channel 4 and sixth-harmonic interference in channel 8. Sound in channel 7 may be interfered with by the fifth harmonic of the vision i.f. if the latter is mistuned by +50 kc/s.

621.397.62 **2521**

"Leningrad" T-2 — Modern Russian TV Receiver.—(*Tele-Tech*, Jan. 1954, Vol. 13, No. 1, pp. 90–92.) Circuit diagram and chassis photographs of this 8-in.-screen receiver are shown.

621.397.62 **2522**

How to Handle Ringing in Television Design.—L. Beiser. (*Electronics*, May 1954, Vol. 27, No. 5, pp. 162–167.) A discussion of the precautions necessary in the design of the various parts of the receiver deflection system to avoid extraneous vertical-bar patterns on the raster caused by transient oscillations in the output circuits.

621.397.62 **2523**

A Direct-Drive Scanning Circuit.—E. Jones & K. E. Martin. (*J. Telev. Soc.*, Jan./March 1954, Vol. 7, No. 5,

pp. 190–199.) A circuit based on that described in U.S.A. patent No. 2555831 (Tourshou) is discussed. The operation differs fundamentally from that of the widely used Blumlein energy-recovery circuit. The scanning coil is in series with an anode inductor whose function is to store energy during the scanning stroke and give it up during the flyback; but there is no coupling between the two coils. D.c. is excluded from the scanning coil and a h.v. winding is provided on the anode inductor. A practical circuit is illustrated, with component values.

621.397.62 : 535.623 : 621.385.831 **2524**

Beam-Deflection Tube Simplifies Color Decoders.—R. Adler & C. Heuer. (*Electronics*, May 1954, Vol. 27, No. 5, pp. 148–151.) See 2244 of July.

621.397.62 : 621.314.7 **2525**

A Symmetrical-Transistor Phase Detector for Horizontal Synchronization.—B. Harris & A. Macovski. (*RCA Rev.*, March 1954, Vol. 15, No. 1, pp. 18–26.) A junction transistor with identical collector and emitter junctions is used in place of a conventional double diode as a balanced phase detector for controlling the line-deflection oscillator of a television receiver. The circuit is gated by application of synchronizing pulses to the transistor base, while the comparison sawtooth voltage is applied to the collector-emitter. Wide variations in the absolute values of the transistor parameters, in the degree of symmetry of the transistor, and in the temperature are tolerable.

621.397.62 : 621.385 **2526**

Investigation of Ultra-High-Frequency Television Amplifier Tubes.—Wen Yuan Pan. (*RCA Rev.*, March 1954, Vol. 15, No. 1, pp. 27–45.) An investigation is made of the possibility of improving receiver performance by including an u.h.f. amplifier stage. Various types of available valve, including planar, pencil and miniature, are considered from the point of view of noise, gain and stability. The results indicate that no substantial advantage is obtainable with any of the available valves, particularly when the additional cost is taken into account.

621.397.62 : 621.397.335 **2527**

A Critical Review of Synchronizing Separators with Particular Reference to Correct Interlacing.—G. N. Patchett. (*J. Brit. Instn Radio Engrs*, May 1954, Vol. 14, No. 5, pp. 191–214.) See 2918 of 1952.

621.397.62.001.4 **2528**

Measurements on Television Receivers: Part 2 — Measurement of Transmission Characteristics of Television Receiver Circuits.—Macek. (See 2479.)

621.397.7 : 628.972 **2529**

Television Lighting Routines.—W. R. Ahern. (*J. Soc. Mot. Pict. Telev. Engrs*, March 1954, Vol. 62, No. 3, pp. 189–196. Discussion, pp. 196–198.) Description of the lighting installation at N.B.C. studio 8H and account of the lighting procedure for a typical play.

621.397.828 : 621.396.61.013.78 **2530**

Screening Materials for TVI.—R. Glaisher. (*Short Wave Mag.*, March 1954, Vol. 12, No. 1, pp. 16–18.) The radiation from a 50-Mc/s test transmitter screened with different materials was measured. The conductivity of mesh screens is improved by bonding with solder strips at 2-in. intervals; this greatly reduces effects of oxidation. Close-stranded copper mesh thus treated is only slightly less effective at 50 Mc/s than copper-plated steel, the best of the solid materials tested.

TRANSMISSION

621.376.22 : 621.3.018.783 **2531**

Intermodulation Distortion in Rectifier Modulators.—D. G. Tucker. (*Wireless Engr*, June 1954, Vol. 36, No. 6, pp. 145–152.) Distortion due to interference of the modulation voltage with the rectifier-switching function of the carrier is studied. Analysis previously given by Belevitch (2184 of 1949 and 1633 and 2167 of 1950) for the case of a single modulation tone is extended to deal with modulation by two or more tones. The rectifiers are assumed to be linear. For the case of two modulation tones values of all third-order distortion terms are tabulated based on first- and third-order modulation. An appendix extends this in general form to all orders of modulation and to second- as well as third-order distortion.

621.376.54 **2532**

Pulse Duration Modulator Circuit.—F. Butler. (*Electronic Engng*, April 1954, Vol. 26, No. 314, pp. 153–155.) Adaptation of the pulse-generator circuit described by Levell (364 of 1953) for single-channel voice-communication purposes. Smooth changes of pulse duration between 12·8 and 0·7 μs are obtained on applying a direct control voltage of value between 15 and 280 V via a high resistance. The pulse-duration/control-voltage characteristic has the form of a rectangular hyperbola. The circuit of a complete modulated generator is illustrated. Trigger pulses with a repetition rate adjustable to 12 kc/s are provided; modulation frequencies up to 6 kc/s are hence permissible. A method of reducing distortion is indicated.

621.396.61 : 621.314.22.029.51/53 **2533**

Tankless Low-Frequency Transmitter.—P. Gomard. (*Electronics*, May 1954, Vol. 27, No. 5, pp. 154–156.) Reduction of the size of a transmitter by use of iron-cored h.f. transformers was described by Deise & Gregory (1284 of 1950). The transmitter here described covers the frequency bands 280–330 kc/s and 400–510 kc/s, using a straight wide-band amplifier with coupling transformers wound on ferrite cores. The oscillator is coupled to the amplifier through a low-pass filter, separate filters being used for the two bands. The output stage comprises eight Type-807 valves in push-pull parallel. The design of the output transformer is considered particularly; the measured temperature rise of 37°–39°C at the ferrite core is in fair agreement with the calculated value.

621.396.61.013.78 : 621.397.828 **2534**

Screening Materials for TVI.—Glaisher. (See 2530.)

VALVES AND THERMIONICS

621.314.632 + 621.314.7 **2535**

The Double-Base Diode: A Semiconductor Thyratron Analog.—R. W. Aldrich & I. A. Lesk. (*Trans. Inst. Radio Engrs*, Feb. 1954, Vol. ED-1, No. 1, pp. 24–27.) The double-base diode consists of a single-crystal Ge bar with a single *p-n* junction and two base contacts. With suitable biasing current flowing between these contacts a junction-base characteristic with a stable negative-resistance region can be obtained, the order of magnitude of the junction currents being much greater than that of the emitter input characteristic of the point-contact transistor. The device is thus suitable for relaxation-oscillator and switching applications; some simple circuits are illustrated.

621.314.632 **2536**

Diode Theory in the Light of Hole Injection.—J. A. Swanson. (*J. appl. Phys.*, March 1954, Vol. 25, No. 3,

pp. 314–323.) Classical diode theory, as applied to metal point contacts made to an n-type semiconductor, is adequate only for small forward voltages at which, under certain conditions, hole current may be negligible. The shape of the predicted diode characteristic is not affected by hole injection at low voltages. For voltages exceeding a critical value, dependent on the resistivity of the material, the spreading resistance is comparable to the barrier resistance, and it is the hole-injection process which accounts for continued rectification. The extent to which the spreading resistance is decreased by hole injection depends on the ratio, γ, of hole current to total current. The effect of γ on the characteristic at high voltages is considered, and a method of measuring γ is indicated.

621.314.7 **2537**

Frequency Variations of Junction-Transistor Parameters.—R. L. Pritchard. (*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, pp. 786–799.) The equivalent-T-network representation of the transistor is adopted in which the four independent small-signal parameters to be considered are the emitter resistance, the base resistance, the parallel combination of collector resistance and capacitance and the effective current-amplification factor. Analysis given by Early (874 of 1953) is extended to account for observed frequency variation of collector impedance. The transistor voltage/current relations are calculated for the theoretical model using the grounded-base connection.

621.314.7 **2538**

High-Frequency Operation of *P*-Type Point-Contact Transistors.—F. L. Hunter & B. N. Slade. (*RCA Rev.*, March 1954, Vol. 15, No. 1, pp. 121–134.) The characteristics of n-type and p-type Ge point-contact transistors are compared. Higher operating frequencies can be attained with the p-type because of the greater mobility of the minority carriers, which in this case are electrons. An α-cut-off frequency as high as 50 Mc/s with a point spacing of 0·001 in. has been attained in amplifier transistors, and an operating frequency as high as 425 Mc/s with oscillator transistors.

621.314.7+621.314.63] : 621.318.57 **2539**

Switching Time in Junction Diodes and Junction Transistors.—R. H. Kingston. (*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, pp. 829–834.) An approximate solution for the transient occurring when a junction diode is switched from forward to reverse conduction is obtained by considering the behaviour of the minority carriers. Two phases are distinguished, (*a*) a constant-current phase in which the flow is limited by the external resistance, (*b*) a 'collection' phase in which the current decays at a rate determined by the minority-carrier lifetime and by the diode dimensions. The duration of the two phases is determined theoretically for a planar junction, a hemispherical junction and a narrow-base diode. By considering the diode in the last of these cases as the emitter-base combination of a transistor, the corresponding collector-current transient is found.

621.314.7 : 621.373.52 **2540**

Internal Oscillations and Microwaves in Transistors.—H. E. Hollmann. (*Naturwissenschaften*, March 1954, Vol. 41, No. 6, p. 136.) An effect in transistors superficially similar to Barkhausen oscillations is briefly reported. The oscillation frequency is proportional to the square root of the collector current and depends on the effective electrode capacitances. In the case of point contact transistors with high α-cut-off frequencies the fundamental resonance frequency is about 100 Mc/s and the microwave harmonics are capable of exciting cavity resonators. For a fuller account, in English, see *Tele-Tech*, April 1954, Vol. 13, No. 4, pp. 75–77.

621.314.7 : 621.397.62 **2541**

A Symmetrical-Transistor Phase Detector for Horizontal Synchronization.—Harris & Macovski. (See 2525.)

621.314.7.012.8 **2542**

Transistor Characteristics.—H. Beneking. (*Arch. elekt. Übertragung*, Feb. 1954, Vol. 8, No. 2, pp. 69–74.) The representation of transistors by equivalent quadripoles is discussed and the advantages of one particular representation are illustrated by two numerical examples. The equivalent of various other Π and T networks is shown.

621.383.2 : 621.317 **2543**

The Photodianode: Investigation of the Total Current and of the Differential Current in an Asymmetrical Arrangement.—L. Deloffre, É. Pierre & J. Roig. (*C. R. Acad. Sci., Paris*, 15th March 1954, Vol. 238, No. 11, pp. 1213–1215.) Modified methods of operating the photodianode (1249 of April) are described. Either gas-filled or vacuum-type photocells can be used.

621.383.5 : 621.396.822 **2544**

Shot Dependence of *p-n* Junction Phototransistor Noise.—A. Slocum & J. N. Shive. (*J. appl. Phys.*, March 1954, Vol. 25, No. 3, p. 406.) Measurements of a.c. short-circuit noise current in a band about 400 c/s wide centred at 1 000 c/s have been made on seven p-n junction phototransistors with low d.c. reverse saturation dark current. Results show that for bias voltages <20 V, and d.c. bias current $<300\,\mu$A, noise current is given within a factor of 2 by the theoretical shot noise current, and is independent of temperature. For bias voltages >20 V, and d.c. bias current $>300\,\mu$A, the noise current is considerably in excess of shot noise current.

621.385 : 621.397.62 **2545**

Investigation of Ultra-High-Frequency Television Amplifier Tubes.—Wen Yuan Pan. (See 2526.)

621.385.029.6 **2546**

Electron-Beam Focusing with Periodic Permanent-Magnet Fields.—J. T. Mendel, C. F. Quate & W. H. Yocom. (*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, pp. 800–810.) Microwave-valve beams can be focused by a system of N permanent magnets arranged periodically along the beam, having a total weight theoretically only $1/N^2$ that of a permanent magnet producing a uniform field over the same length, for comparable results. For certain combinations of beam voltage and magnetic field, 'stop bands' are produced in which the beam becomes unstable and no current reaches the collector; design procedure for avoiding this effect is indicated.

621.385.029.63 **2547**

The Effect of Space Charge on Beam Loading in Klystrons.—T. G. Mihran. (*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, p. 862.) Analysis indicates that space charge can be neglected in calculating primary electron beam loading but must be taken into account for secondary electron beam loading.

621.385.029.63 **2548**

Improvement of Power Output from Pulsed Klystrons.—J. H. Jasberg. (*Proc. Inst. Radio Engrs*, May 1954, Vol. 42, No. 5, p. 849.) Klystrons of the type described by Chodorow et al. (580 of February) have been modified to give considerably higher outputs and improved efficiencies.

621.385.83 : 621.397.62 : 535.623 **2549**

Beam-Deflection Tube simplifies Color Decoders.—R. Adler & C. Heuer. (*Electronics*, May 1954, Vol. 27, No. 5, pp. 148–151.) See 2244 of July.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.232 : 534.321.9 **2550**

Devices for generating Ultrasonic Waves in Air, using Vibrating Cylinders, Pistons, Spheres and Cubes.—V. Gavreau & M. Miane. (*Acustica*, 1954, Vol. 4, No. 3, pp. 387–395. In French.) Electrodynamic types of ultrasonic generator are particularly suitable for laboratory acoustic measurements. Focused arrangements and regenerative systems for high frequencies (77 kc/s) are described. Visual methods for studying the vibrations of the emitting surfaces are discussed. Application to the absolute calibration of microphones at ultrasonic frequencies is indicated.

534.44 **2551**

Investigation of Nonperiodic [noise] **Processes by means of Autocorrelation and Fourier Analysis.**—M. L. Exner. (*Acustica*, 1954, Vol. 4, No. 3, pp. 365–379. In German.) The two methods were compared by analysing filtered noises and hisses. For frequency and bandwidth determinations the Fourier-analysis method is preferred, but for energy-distribution determinations the autocorrelation method is better.

534.614 **2552**

The Effect of Slip on Sound Propagation.—D. E. Weston. (*Proc. phys. Soc.*, 1st March 1954, Vol. 67, No. 411B, p. 265.) Comment on 615 of March (Caro & Martin).

534.64 **2553**

Acoustic Impedance Measurement using a Resonance Method.—M. A. Ferrero & G. G. Sacerdote. (*Acustica*, 1954, Vol. 4, No. 3, pp. 359–364.) See 2545 of 1953.

534.64 **2554**

Determination of High Mechanical Input Impedances of Solid Bodies in the Frequency Range 50–3 000 c/s.—W. Elling. (*Acustica*, 1954, Vol. 4, No. 3, pp. 396–402. In German.) An electromechanical vibrometer is described and measurements on walls, ceilings and Al plates are reported. The results show that the reactive part of the impedance of ceilings and walls is an inertance at low frequencies and a stiffness at high frequencies; the change-over occurs at about 150–300 c/s, where the resistive part of the impedance is a maximum.

534.78 **2555**

The Experimental Study of Speech.—D. B. Fry. (*Nature, Lond.*, 8th May 1954, Vol. 173, No. 4410, pp. 844–846.) A survey of recent work on the analysis and synthesis of speech.

534.845 **2556**

Improvement of the Effectiveness of Acoustic Panels by use of Resonators.—G. Kurtze. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st March 1954, Vol. 32, No. 3, pp. 81–87.) The absorptive effect of the panel material is supplemented, particularly at low frequencies, by providing circular holes or slits, so as to form resonators. Empirical formulae are used for the calculations. Absorption/frequency characteristics and studio reverberation-time/frequency curves illustrate the improvement attained.

534.846.6 **2557**

Polycylindrical Systems and the Diffusion of Sound Waves.—R. Lamoral. (*Onde élect.*, March 1954, Vol. 34, No. 324, pp. 308–309.) A study was made of the suppression of echoes in rooms by means of polycylindrical surfaces, using 1 : 50 reduced-scale models and frequencies between 5 and 30 kc/s. The results are presented in a family of curves for different distances between source and reflecting surface. Echo suppression improves as this distance increases, and at all distances is best for wavelengths between 0·5 d and d (d = cylinder chord).

621.395.6 **2558**

Developments in Sound Reproduction.—(*Wireless World*, July 1954, Vol. 60, No. 7, pp. 313–317.) Review of products shown at exhibitions held by the Radio and Electronic Component Manufacturers' Federation, the Association of Public Address Engineers, and the British Sound Recording Association.

621.395.61 : 621.391.5 **2559**

The "Vagabond" Wireless Microphone System.—Phinney. (See 2765.)

621.395.625 **2560**

Congress on Sound Recording — Paris 1954.—H. J. Houlgate. (*Wireless World*, July 1954, Vol. 60, No. 7, pp. 348–350.) About 60 papers were presented and discussed at the 'International Conference on Sound Recording Processes and their Extension to the Recording of Information', held in April 1954. Points from the discussions and items of interest in the associated exhibition are noted. The full text of many of the papers and abstracts of others are given in *Onde élect.*, March 1954, Vol. 34, No. 324, pp. 193–294.

621.395.625.3 **2561**

Synchronized Magnetic Tape Recording.—R. H. Ranger. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 581–586.) The longitudinally magnetized sound track on a ¼-in. tape for use with film is synchronized by recording on the same tape a control track consisting of transverse-magnetization signals derived from the a.c. power driving both the tape and the camera.

AERIALS AND TRANSMISSION LINES

621.372 **2562**

Coupled Wave Theory and Waveguide Applications.—S. E. Miller. (*Bell Syst. tech. J.*, May 1954, Vol. 33, No. 3, pp. 661–719.) Theory applicable to coupled transmission lines, including waveguides and helical lines, is developed. For loose coupling, when very little power is transferred, the length of the coupling region can be reduced by tapering the coupling. For tight coupling distributed uniformly in the direction of propagation, energy is exchanged periodically provided that the attenuation and phase constants of the two lines are equal or nearly so. Experiments have confirmed the theory. Applications include pure-mode couplers in multimode systems, and wave filters.

621.372.8 : [537.562 + 621.318.134 **2563**

Topics in Guided-Wave Propagation through Gyromagnetic Media: Part 1—The Completely Filled Cylindrical Guide.—H. Suhl & L. R. Walker. (*Bell Syst. tech. J.*, May 1954, Vol. 33, No. 3, pp. 579–659.) "The characteristic equation for the propagation constants of waves in a filled circular guide of arbitrary radius is written in terms of magnetizing field and a carrier density, which are shown essentially to determine the dielectric and permeability tensors for a gas discharge plasma and for a ferrite. The complex structure of the spectrum of propagation constants and its dependence upon radius and the two parameters are analysed by a semigraphical method, supplemented by exact formulae in special regions. Thus the course of individual modes may be charted with fair accuracy."

621.372.8 : 538.614 **2564**

Gyrotropic Waveguide.—M. A. Gintsburg. (*C. R. Acad. Sci. U.R.S.S.*, 21st March 1954, Vol. 95, No. 3, pp. 489–492. In Russian.) The theory is developed of e.m. propagation in a bounded anisotropic medium, in particular in waveguides which are partly or completely filled with a medium with μ_{ik} and ϵ_{ik} varying with direction. Such 'gyrotropic' (rotation-producing) media can be obtained by using the Faraday or Kerr effects or similar phenomena. The final set of equations derived indicates a method of determining the components of the non-symmetric tensors representing μ_{ik} and ϵ_{ik} by means of a resonator. See also 2710 of 1952 (Suhl & Walker).

621.396.67 **2565**

An Experimental Study of a Microwave Periscope.—J. Drexler. (*Proc. Inst. Radio Engrs*, June 1954, Vol. 42, No. 6, p. 1022.) Experiments were made to test the validity of the theoretical result obtained by Jakes (1243 of 1953) that it is possible to obtain more power from a combination of aerial and reflector than from the same aerial located at the reflector position. For one particular case the gain of the combination was 2·3 db above that of the aerial alone.

621.396.67 : 621.397.6 **2566**

Cosecant Antenna aids U.H.F.-TV Coverage.—J. E. Martin & J. Ruze. (*Electronics*, June 1954, Vol. 27, No. 6, pp. 138–142.) An aerial designed to give uniform field strength over the service area comprises four vertical tubes of structural steel, of outer diameter 4 in., arranged with their cross-sections in a square and their axes 5 in. apart, these tubes constituting the outer conductor of a coaxial system. Rings of slot radiators with centres spaced one wavelength apart are formed between steel welding members. Details are given of feed arrangements and radiation patterns obtained. Coverage was tested by operation at a television station on 790 Mc/s.

621.396.67.012.12 : 517.864 **2567**

The Maximal Directivity Coefficient of Linear and Plane Aerials.—L. D. Bakhrakh. (*C. R. Acad. Sci. U.R.S.S.*, 1st March 1954, Vol. 95, No. 1, pp. 45–48. In Russian.) The radiation-pattern function is given in terms of a series of Mathieu functions of aerial length, l, in wavelengths, λ, and of direction angle, of orders up to the nth (see 1675 of June). The condition for the directivity coefficient to be a maximum in a given direction, for a given value of n, and expressions for the resultant field and aerial losses are derived. Results of calculations for $l/\lambda = 10{\cdot}58$ are shown graphically.

621.396.676 : 621.396.93 **2568**

U.H.F. Omnidirectional Antenna Systems for Large Aircraft.—W. Sichak & J. J. Nail. (*Trans. Inst. Radio Engrs*, Jan. 1954, Vol. AP-2, No. 1, pp. 6–15.) Experiments have been made on models to investigate the siting of aerials on different types of aircraft. Analysis of results is based on the probability of attaining free-space-dipole range for all azimuth angles and $\pm 30°$ elevation. The operation of dual aerial systems for navigation and traffic-control equipment is discussed. Direct parallel feed of dual aerials gives an interference region where individual radiation patterns overlap; in this region, a radar beacon may operate satisfactorily but the performance of d.m.e. is uncertain. Delay-line, switching and phase-shift systems of operation are considered. The simplest common-aerial arrangement is the operation of nose and tail aerials in parallel, with hybrid multiplexing.

621.396.677.3 **2569**

A Method for Calculating the Current Distribution of Tschebyscheff Arrays.—D. Barbiere. (*Proc. Inst. Radio Engrs*, June 1954, Vol. 42, No. 6, p. 1021.) Discussion on 1211 of 1952.

621.396.677.43 **2570**

Rhombic Antennas for Transmitting Stations.—L. Leng. (*Brown Boveri Rev.*, Oct. 1953, Vol. 40, No. 10, pp. 407–416.) The radiation diagram of a rhombic aerial is analysed taking account of the attenuation due to radiation. Values of maximum gain attainable with a single rhombic of characteristic impedance 600 Ω are noted and the design and application of single and double rhombic aerials for point-to-point transmission and for transmission to a specific zone are considered.

621.396.677.43.011.21 **2571**

Mutual Impedance of Stacked Rhombic Antennas.—J. G. Chaney. (*Trans. Inst. Radio Engrs*, Jan. 1954,

Vol. AP-2, No. 1, p. 39.) A formula derived earlier (3199 of 1953) is integrated for the case of two identical rhombic aerials; the resultant expression involves associated sine and cosine integral functions.

621.396.677.71 2572

Mutual Coupling Considerations in Linear-Slot Array Design.—M. J. Ehrlich & J. Short. (*Proc. Inst. Radio Engrs*, June 1954, Vol. 42, No. 6, pp. 956–961.) An experimental study was made of the external coupling between slots in adjacent resonant waveguides on a finite ground plane. Measurements were made of the field strength in one of the guides on exciting the other guide, and of the change in input admittance of the driven slot due to the presence of the parasitic slot, with matched termination of the parasitic waveguide. The results indicate that the slot-coupling effect can generally be neglected in the design of linear slot arrays.

621.396.677.83 : 621.396.96 2573

Torque Requirements of a Radar Antenna.—M. Mark. (*Elect. Engng, N.Y.*, March 1954, Vol. 73, No. 3, pp. 262–264.) Results are given of wind-tunnel tests on an experimental radar aerial. The torque required to rotate the aerial varied with azimuth position, elevation angle, pivot location, speed of rotation, and wind velocity. The combined results are evaluated on the basis of dimensionless parameters.

621.396.677.85 2574

The Electromagnetic Field near a Dielectric Lens.—D. C. Hogg. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, p. 542.) The field components along the electric and magnetic diameters differ considerably near the lens surface. The spacing between successive maxima of field intensity along the magnetic diameter near the optic axis is of the order of the wavelength in the dielectric. Virtual sources along the aperture edge, as suggested by Andrews (3141 of 1950), can account for these observations.

AUTOMATIC COMPUTERS

681.142 2575

Solutions of Boundary-Value Problems on Automatic Computing Equipment.—F. M. Verzuh. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 813–821.) Report of an investigation in which five types of digital computer and one differential analyser were compared as regards their suitability for solving boundary-value problems.

681.142 2576

A Progressive Code Digital Quantizer.—F. Raasch. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 567–571.) Description of an analogue-to-digital converter which receives information from a graph reader and gives a corresponding numerical indication. Several circuits are shown, based on the principle of comparing the analogue voltage with the sum of a finite geometric series.

681.142 2577

The Manchester University High-Speed Digital Computer.—D. B. G. Edwards. (*J. Brit. Instn Radio Engrs*, June 1954, Vol. 14, No. 6, pp. 269–278.) See 978 (Kilburn et al.) and 979 (Pollard & Lonsdale) of April.

681.142 2578

A Mercury Delay-Line Memory Unit.—R. D. Ryan. (*Proc. Instn Radio Engrs, Aust.*, April 1954, Vol. 15, No. 4, pp. 89–95.) The storage unit in the C.S.I.R.O. digital computer [1050 of 1953 (Beard & Pearcey)] is described; a method is discussed of interspacing the pulses of one loop between those of another loop, thus doubling the storage capacity.

681.142 2579

A Review of Magnetic and Ferroelectric Computing Components.—V. L. Newhouse. (*Electronic Engng*, May 1954, Vol. 26, No. 315, pp. 192–199.) High-speed digital storage devices may be classified as delay-line or random-access types, with subdivisions in each case for regenerative and nonregenerative devices. The more important magnetic and ferroelectric storage units are critically discussed and possible future lines of development indicated. 26 references.

681.142 2580

An Arithmetic Unit for Automatic Digital Computers.—J. R. Stock. (*Z. angew. Math. Phys.*, 15th March 1954, Vol. 5, No. 2, pp. 168–172. In English.) Discussion of the requirements for the arithmetic unit of a computer with magnetic-drum store, with particular reference to the computer for the Swiss Federal Institute of Technology. Operation with fixed or floating decimal point is provided for.

681.142 2581

Magnetic Switching Circuits.—R. C. Minnick. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, pp. 479–485.) Magnetic circuits to produce the logical operations of 'and' and 'or' are described, which may be combined to produce any switching function of any number of input binary variables. The only components used are magnetic cores, wire and resistors. There is no extremely sensitive parameter in these circuits which must be adjusted carefully in order to ensure proper operation.

681.142 : 512 2582

A Simplified Solution and New Application of an Analyser of Algebraic Polynomials.—L. Lukaszewicz. (*Bull. Acad. polon. Sci.*, 1953, Vol. I, No. 3, pp. 103–107. In English.) A description is given of an analyser circuit in which complex numbers are represented by sinusoidal voltages of frequency ~500 c/s, with amplitude corresponding to the modulus and phase corresponding to the argument of the number.

681.142 : 621.385.832 2583

An Electron-Beam Tube for Analog Multiplication.—E. J. Angelo, Jr. (*Rev. sci. Instrum.*, March 1954, Vol. 25, No. 3, pp. 280–284.) An electron beam of large circular cross-section and uniform current density is projected through an e.s. deflection system on to a metallic target made up of four quadrants insulated from one another. The currents collected by one diagonal pair of quadrants are arranged to oppose those collected by the other pair, thus the algebraic sum of the currents in the quadrants is proportional to the product of the deflection voltages. The design and performance of the system is discussed.

CIRCUITS AND CIRCUIT ELEMENTS

621.314.2 2584

Prevention of Ionization in Small Power Transformers.—L. Medina. (*Proc. Instn Radio Engrs, Aust.*, May 1954, Vol. 15, No. 5, pp. 114–115.) The ionization-onset voltage is raised, for a given total thickness of insulation, by inserting foils in the insulation so as to split it into n sections with $1/n$ of the total voltage across each section. Design details and test results for a typical transformer are given.

621.316.8 + 621.319.4 **2585**

Some Characteristics and Limitations of Capacitor and Resistor Components.—L. Podolsky & J. K. Sprague. (*Trans. Inst. Radio Engrs*, March 1954, No. PGCP-1, pp. 33–46.) Six types of film-dielectric capacitors are examined with respect to their performance. Specifications for a new and reliable type of metallized-paper capacitor, at the pilot-plant development stage, are given. A satisfactory method for power rating of precision bobbin resistors is explained.

621.318.134 : 621.318.5 **2586**

Stressed Ferrites having Rectangular Hysteresis Loops.—H. J. Williams, R. C. Sherwood, M. Goertz & F. J. Schnettler. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 531–537.) To obtain the rectangular hysteresis loop required in ferrite cores used in switching and storage devices, the cores are stressed by encasing them in plastics which shrink during polymerization.

621.318.4 **2587**

Temperature Fields in Electrical Coils: Numerical Solutions.—P. J. Schneider. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 768–771.) The computation of the steady temperature fields in coils by the relaxation method is described and illustrated.

621.318.435 **2588**

Saturable Reactors with Inductive D.C. Load: Part 2—Transient Response.—H. F. Storm. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 182–192.) Part 1: 3527 of 1953.

621.318.57 **2589**

A Graphical Method for Flip-Flop Design.—R. F. Johnston & A. G. Ratz. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 52–56.)

621.318.57 **2590**

Switching in Bistable Circuits.—R. S. Mackay. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, pp. 424–429.) All triggering processes seem capable of description in terms of a curve with a region of negative slope, points on this curve representing unstable states, while points on a positive slope represent stable states. A negative-resistance circuit in which the voltage is a multiple-valued function of current was constructed so that details of the triggering process could be observed on an oscilloscope screen. By suitable periodic sampling a slow-motion representation of the transition between two states is obtained.

621.318.57 **2591**

An Electronic Random Selector.—R. W. Walker. (*J. Brit. Instn Radio Engrs*, June 1954, Vol. 14, No. 6, pp. 262–268.) Criteria for recognition of random series are stated and methods for producing such series are discussed. A description is given of an arrangement in which pulses are applied to a circuit which is gated periodically; any pulse passing through the gate triggers a multivibrator which is in turn coupled to a pair of mechanical registers. Two such circuits make up the complete selector enabling four mechanical registers to operate. Use of the selector in psychical research is mentioned.

621.318.57 : 621.314.7 **2592**

The Transient Response of Transistor Switching Circuits.—I. L. Lebow & R. H. Baker. (*Proc. Inst. Radio Engrs*, June 1954, Vol. 42, No. 6, pp. 938–943.) Transient response of the point-contact transistor in a grounded-base circuit is considered, using a linearized equivalent circuit. The required trigger voltages for both directions of switching are found experimentally to be greater than suggested by the static characteristic, and to depend on trigger pulse width to a different extent for the two directions. To fit these findings it is assumed that cut-off frequency is high when the transistor is switched off and low when it is switched on. The one-shot multivibrator is discussed in the light of these assumptions.

621.318.57 : 621.387 **2593**

A Cold-Cathode Scaling Unit.—C. D. Florida & R. Williamson. (*Electronic Engng*, May 1954, Vol. 26, No. 315, pp. 186–191.) The five-decade scaler uses dekatrons, interstage coupling being by cold-cathode gas-filled trigger triodes. The resolving time is $\sim 500\,\mu s$, which makes it suitable for application in conjunction with G-M counter tubes. Operation under varying climatic conditions has been satisfactory.

621.319.4 : 621.315.612.4 **2594**

The Effect of Minor Constituents in High Dielectric Constant Titanate Capacitors.—W. W. Coffeen. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 704–709.) Additives used to modify the dielectric properties of $BaTiO_3$ are classified into two groups, those which alter the position of the Curie peak and those which lower its height. $BaSnO_3$ and $PbSnO_3$ are typical of the first group, while $MgSnO_3$, $Bi_2(SnO_3)_3$, $MgTiO_3$ and $CaTiO_3$ are typical of the second. The effect of composition on nonlinearity and aging is discussed. See also 191 and 192 of January.

621.319.4.001.4 **2595**

Breakdown and Leakage Resistance Investigation of Metallized-Paper Capacitors.—J. Burnham. (*Trans. Inst. Radio Engrs*, March 1954, No. PGCP-1, pp. 3–17.) The basis of comparison between conventional paper and metallized-paper capacitors is discussed. Experiments on units with polyester impregnants suggest that, if self-healing is of primary importance, a pure aliphatic hydrocarbon type of impregnant will give best results.

621.372 : 517.948 **2596**

Applications of Integral Equations to the Solution of Nonlinear Electric Circuit Problems.—L. A. Pipes. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 445–450.) The technique described gives practical results in many cases where the approximate solution of the integral equation may be effected by means of Laplace transforms.

621.372.52 + 621.375.4 **2597**

Junction Transistor Circuits.—(*Radio & Electronics, Wellington, N.Z.*, 1st March 1954, Vol. 9, No. 1, pp. 18–19..23.) Application of the CK722 *p-n-p* junction-type transistor in single-stage and cascaded amplifiers and in l.f. and r.f. oscillators, is described and illustrated by eight circuit diagrams. The transistor collector characteristics, and operating data and typical circuit component values are given.

621.372.55 **2598**

Spectrum or Waveform Equalization?—D. A. Bell. (*Wireless Engr*, July 1954, Vol. 31, No. 7, pp. 171–174.) The method of equalization in which signals obtained by differentiation or integration are added to the main signal [1936 of 1953 (Gouriet)] is compared with the commoner method using filters. Empirical design is simpler with the former method, but the need for additional amplification at high frequencies is not avoided. The different requirements of communication and servo systems are indicated.

621.372.8 : 538.614 **2599**

New Effect caused by Gyromagnetic Phenomena.—K. M. Polivanov. (*C. R. Acad. Sci. U.R.S.S.*, 21st March 1954, Vol. 95, No. 3, pp. 501–503. In Russian.) Theory is given of a device similar to that described by Kales et al. (2040 of July).

621.373 **2600**

Effects of Harmonics on the Frequency of Oscillation as well as on the Asymmetry of the Resonance Curves.—A. E. Mostafa. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 309–314.) The nonlinear equations representing the free and synchronized oscillations are transformed into linear equations with periodically varying coefficients, and complete solutions are obtained. The relation between frequency variation and harmonic content is derived. Experimental results supporting the theory are reported.

621.373 **2601**

The First Order Behavior of Separable Oscillators.—D. C. de Packh. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 450–455.) Analysis is given for oscillators whose linear and nonlinear elements are separable in the first order. Theoretical and experimental results indicate that, apart from adjustments of the linear elements, the major factor for obtaining frequency stability and smooth control is the suppression of the even-power terms in the amplitude characteristic.

621.373 : 621.396.822 : 530.145 **2602**

Quantum Theory of a Damped Electrical Oscillator and Noise: Part 2 — The Radiation Resistance.—J. Weber. (*Phys. Rev.*, 15th April 1954, Vol. 94, No. 2, pp. 211–215.) The results obtained in part 1 (3243 of 1953) are extended to include damping and noise due to a radiation resistance and expressions for the mean square noise voltage and available noise power are derived which are shown to be the same as those previously obtained. They are also extended to apply to a single mode of a cavity resonator.

621.373 : 621.396.822 : 530.145 **2603**

Vacuum Fluctuation Noise.—J. Weber. (*Phys. Rev.*, 15th April 1954, Vol. 94, No. 2, pp. 215–217.) The possibility of observing vacuum fluctuations by measuring the resultant electron stream noise when an electron stream interacts with a damped oscillator is discussed. An electron stream is shown to provide a means of precise measurement of the mean square noise e.m.f. for certain modes. The circuit must be at low temperature.

621.373.421 + 621.375.23].001.2 **2604**

Block-Diagram Solutions for Vacuum-Tube Circuits.—T. M. Stout. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 561–567.) Full paper. See 1346 of May.

621.373.421.13.029.65 **2605**

Millimeter Waves from Harmonic Generators.—C. M. Johnson, D. M. Slager & D. D. King. (*Rev. sci. Instrum.*, March 1954, Vol. 25, No. 3, pp. 213–217.) Fundamental and harmonic powers obtainable at wavelengths down to 1·9 mm, using a Si-crystal frequency multiplier with different types of reflex klystron, have been measured. Three types of multiplier are compared; these are (*a*) a commercial Si crystal mounted upright on the exterior face of the harmonic waveguide; (*b*) a crystal with windows cut in the face so that the tungsten whisker is exposed; (*c*) a whisker and Si block mounted in the waveguide. Arrangement (*b*) is the most satisfactory for wavelengths below 4 mm. The performance of arrangement (*c*) as a detector is discussed. A crystal harmonic generator used with a narrow-band amplifier will furnish enough power at 3-mm wavelength to give a dynamic range of 50–60 db.

621.373.424 : 621.396.621.54 **2606**

Variable-Frequency Crystal-Controlled Receivers and Generators.—Wadley. (See 2759.)

621.373.431 + 621.373.444.1 **2607**

A Modified Miller Timebase Circuit.—R. D. Ryan. (*J. sci. Instrum.*, March 1954, Vol. 31, No. 3, pp. 73–75.) High linearity and rapid flyback are achieved by using a blocking oscillator to charge the feedback capacitor in the Miller-type circuit. Compensation is provided for variations in the blocking-oscillator characteristics. A unit giving sweep durations of 5 μs–15 ms with either triggered or continuous operation is described.

621.375.2.024 : 621.387 **2608**

Transient Response of Glow Discharges with Applications.—Mackay & Morris. (See 2828.)

621.375.223 **2609**

L.F. Compensation for Video Amplifiers: Part 1—Amplifiers without Feedback.—J. E. Flood. (*Wireless Engr*, July 1954, Vol. 31, No. 7, pp. 175–186.) Response to unit-step input is considered. The departure from the ideal flat-top response caused by low-frequency distortion can be reduced by making the differential coefficients of the output function equal to zero at $t = 0$. The order of compensation is designated by the number of derivatives equal to zero. General theory is given and is applied to some typical resistance-coupled amplifiers. A single *RC*-coupled stage can have second-order compensation, and multistage amplifiers can have higher orders of compensation. Experimental results confirm the analysis.

621.375.23 : 621.317.44 **2610**

An Electronic Voltage Integrator.—R. Madey & G. Farly. (*Rev. sci. Instrum.*, March 1954, Vol. 25, No. 3, pp. 275–279.) A feedback amplifier integrating circuit is described. The amplifier comprises a cascode-connected direct-coupled circuit with filament drift compensation and internal positive-feedback adjustment. The integrator is used with a search coil for magnetic-field measurements in the range 500–15 000 gauss; accuracy is within 1%.

621.375.23.029.4 **2611**

A High-Efficiency High-Quality Audio-Frequency Power Amplifier.—A. B. Bereskin. (*Trans. Inst. Radio Engrs*, March/April 1954, Vol. AU-2, No. 2, pp. 49–60; *Convention Record Inst. Radio Engrs*, 1954, Part 6, pp. 18–24.) The circuit uses a Type-12AX7 valve as phase-inverter-amplifier-driver stage direct-coupled to two output beam tetrodes operating in class B push pull, with 24 db of feedback. The output transformer has a bifilar-wound primary, and the feedback winding is electrostatically shielded from the secondary but very closely coupled to it. Full-power output is 60 W at frequencies $< 3\,000$ c/s. Design of the circuits and performance details are described.

621.375.23.029.4 **2612**

The Cascode as a Low-Noise Audio Amplifier.—R. L. Price. (*Trans. Inst. Radio Engrs*, March/April 1954, Vol. AU-2, No. 2, pp. 60–64.)

621.375.3 **2613**

The Influence of Magnetic Amplifier Circuitry upon the Operating Hysteresis Loops.—H. W. Lord. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 721–728.) An analysis limited

to the steady-state characteristics of single-phase self-saturated magnetic amplifiers. Only resistive loads are considered.

621.375.3 **2614**

High-Speed Magnetic Amplifiers.—A. E. Maine. (*Electronic Engng*, May 1954, Vol. 26, No. 315, pp. 180–185.) Units based on Ramey's half-wave amplifier are discussed, and the development of a new series of amplifiers is described. The basic type is a reversing-phase-input/reversing-d.c.-output amplifier. Circuit modifications are explained for obtaining (*a*) reversing d.c. output for reversing d.c. input, and (*b*) reversing-phase a.c. or reversing polarity d.c. output. Other possible modifications are indicated.

621.375.3 : 621.318.1 **2615**

Theory of Magnetic Amplifiers with Square-Loop Core Materials.—H. F. Storm. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 629–637. Discussion, pp. 637–640.)

621.375.4 : 621.314.7 **2616**

Temperature-Stabilized Transistor Amplifiers.—H. J. Tate. (*Electronics*, June 1954, Vol. 27, No. 6, pp. 144–147.) Design equations are derived and nomograms presented for determining the temperature variation of the operating point of a junction-transistor amplifier. Application of the information for temperature stabilization is indicated. Numerical examples are given.

621.375.4 : 621.314.7 **2617**

Transistors in Amplifier Output Stages.—M. J. O. Strutt. (*Scientia elect., Zürich*, Oct. 1953, Vol. 1, No. 1, pp. 2–17.) The optimum effective load impedance and the efficiency are calculated using idealized characteristic curves. The results for point-contact and junction-type transistors in class A and in class B push-pull amplifiers are compared with the corresponding formulae for triodes and pentodes. Distortion, the efficiency limit, and circuit design are also briefly considered.

GENERAL PHYSICS

530.112 **2618**

Proposal for a New Aether-Drift Experiment.—L. Essen. (*Nature, Lond.*, 17th April 1954, Vol. 173, No. 4407, p. 734.) Comment on Furth's proposal (1726 of June) and suggestion for an alternative experimental procedure.

535.22 **2619**

Precision Determination of the Velocity of Light Derived from a Band Spectrum Method: Part 2.—D. H. Rank, J. N. Shearer & T. A. Wiggins. (*Phys. Rev.*, 1st May 1954, Vol. 94, No. 3, pp. 575–578.) From measurements of the rotational constant B_{000} for HCN by the method of exact orders (*J. opt. Soc. Amer.*, 1953, Vol. 43, p. 952) and by a microwave method, the value of c is $299\,789{\cdot}8 \pm 3{\cdot}0$ km/s.

536.49 : 621.319.4 **2620**

Further Experiments on the Thermodielectric Effect (Costa Ribeiro Effect).—A. Dias Tavares. (*Ann. Acad. bras. Sci.*, 31st March 1953, Vol. 25, No. 1, pp. 53–59. In English.) The experiments described establish that on solidification of liquid naphthalene, negative charges are expelled from the solid into the liquid phase, the resultant positive charge being distributed within the solidified dielectric. See also 648 of 1952 (Ribeiro).

536.49 : 621.319.4 **2621**

Further Quantitative Experiments on the Costa Ribeiro Effect.—A. Dias Tavares. (*Ann. Acad. bras. Sci.*, 31st Dec. 1953, Vol. 25, No. 4, pp. 353–373. In English.) In an investigation of the thermodielectric effect (2620 above and back reference), measurements were made of the charge within a solidified naphthalene dielectric by means of a Faraday cage and electrometer. The relation between the charge and the mass is constant. For small crystals this specific residual charge ρ is twice the induced charge per unit mass. Impurities alter the value of ρ considerably.

537.221 **2622**

Contact Charging between a Borosilicate Glass and Nickel.—J. W. Peterson. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, pp. 501–504.) Contact charging of glass spheres rolling on clean Ni was studied under conditions of controlled cleanliness, humidity and gas pressure. The effect of a transverse electric field is important only for high surface conductivity. Surface conduction limits the maximum charge, which also varies with pressure due to gaseous discharge between the sphere and the metal.

537.311.33 **2623**

A Chemical Approach to the Treatment of Electronic Spin in Semiconductors.—J. H. Crawford, Jr, & D. K. Holmes. (*Proc. phys. Soc.*, 1st March 1954, Vol. 67, No. 411A, pp. 294–295.) A method due to Fowler (*Proc. roy. Soc. A*, 1933, Vol. 140, p. 505), in which the electrons and the neutral and ionized donors are treated as chemical entities, affords a simple approach in the non-degenerate case. The results obtained agree with those of Landsberg (78 of 1953) when the occurrence of neutral donors containing unpaired and paired electrons is taken into account.

537.311.62 **2624**

Theory of the Anomalous Skin Effect in a Magnetic Field.—M. Ya. Azbel' & M. I. Kaganov. (*C. R. Acad. Sci. U.R.S.S.*, 1st March 1954, Vol. 95, No. 1, pp. 41–44. In Russian.) Extension of work by Reuter & Sondheimer (1354 of 1949) to take account of the effect of a steady magnetic field.

537.311.62 · 535.137 **2625**

The Effect of Relaxation on Microwave Measurements of the Anomalous Skin Effect.—R. G. Chambers. (*Physica*, April 1953, Vol. 19, No. 4, pp. 365–370.) The ratio of the conductivity to the mean free path of an electron in Bi at microwave frequencies estimated on the basis of Dingle's theory (2626 below) is $1{\cdot}53 \times 10^7 \Omega^{-1}\text{cm}^{-2}$ compared with $2{\cdot}74 \times 10^7 \Omega^{-1}\text{cm}^{-2}$ given earlier by Pippard & Chambers (996 of 1953), neglecting relaxation effects. This discrepancy and the discrepancy for normal metals are discussed.

537.311.62 : 535.137 **2626**

The Anomalous Skin Effect and the Reflectivity of Metals.—R. B. Dingle. (*Physica*, April, Aug. & Dec. 1953, Vol. 19, Nos. 4, 8 & 12, pp. 312–364, 729–736 & 1187–1199.) Expressions derived by Reuter & Sondheimer (1354 of 1949) are considerably simplified. Numerical results obtained include calculated values of surface resistance and reactance in the microwave region for both specular and diffuse electron reflection.

537.52 **2627**

Some Aspects of Breakdown Streamers.—L. B. Loeb. (*Phys. Rev.*, 15th April 1954, Vol. 94, No. 2, pp. 227–232.)

537.523 **2628**

The Electric Strength of Air in Nonuniform Fields at Radio Frequencies.—J. B. Whitehead, D. L. Birx & C. F. Miller. (*Trans. Amer. Inst. elect. Engrs*, 1953,

Vol. 72, Part I, *Communication and Electronics*, pp. 520–524.) Measurements were made of the breakdown potential of atmospheric air between a cylinder and an axial wire, over the frequency range 2–16 Mc/s. The breakdown voltage is about 30% below the 60-c/s value at 2 Mc/s, and decreases at the average rate of 120 V per Mc/s as the frequency is raised above this point. The results are explained by a modified Townsend theory. The discharge occurs during the part of the cycle when the wire is positive with respect to the cylinder.

537.525 **2629**

The Secondary-Electron Resonance Mechanism of Low-Pressure High-Frequency Gas Breakdown.—A. J. Hatch & H. B. Williams. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, pp. 417–423.) Breakdown field strengths were measured in air and H_2 at frequencies from 25 to 90 Mc/s between internal electrodes separated by 1–4 cm. By suddenly applying a high voltage, and reducing it slowly, an upper breakdown curve was observed. This curve, the lower breakdown curve and cut-off frequency data together define a breakdown region. The secondary-electron resonance theories developed by Danielsson and Gill & von Engel (1906 of 1948) are extended.

537.525.3 : 621.387.424 **2630**

Dynamics of Corona Discharge between Cylindrical Electrodes.—L. Colli, U. Facchini, E. Gatti & A. Persano. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, pp. 429–435.) The screening action of the space charge is responsible for the constancy and stability of the average discharge current. Fluctuations are explained as a response of the system having a definite resonance frequency to the statistical fluctuations of the photoelectric current. Theoretical predictions are confirmed by experiment.

537.533 **2631**

The Work Function of Irregular Metal Surfaces.—T. J. Lewis. (*Proc. phys. Soc.*, 1st March 1954, Vol. 67, No. 411B, pp. 187–200.) Calculation of the image potential for spherical and prolate spheroidal bosses on an otherwise smooth surface shows that this potential might be reduced to 50% of its value for an ideal plane surface. Since the image potential is likely to form a large portion of the work function for most metals, the work function will be significantly reduced when the surface is rough.

537.533.8 **2632**

Effect of the Energy Distribution of Electrons on the Average Secondary-Emission Yield of an Insulator.—J. Salmon. (*J. Phys. Radium*, March 1954, Vol. 15, No. 3, p. 190.) An expression for the average yield in terms of electron temperature is calculated for pyrex, the electron energy distribution being Maxwellian.

537.56 **2633**

A Model for Collision Processes in Gases: Part 1 — Small Amplitude Processes in Charged and Neutral One-Component Systems.—P. L. Bhatnagar, E. P. Gross & M. Krook. (*Phys. Rev.*, 1st May 1954, Vol. 94, No. 3, pp. 511–525.)

537.568 **2634**

Electron-Ion Recombination at Low Pressures.—S. Borowitz. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 430–435.) Experiments throwing light on the nature of the fundamental processes involved are discussed: the molecular ion is thought to play a decisive part. The evidence is consistent with the hypothesis of dissociative recombination.

538.114 **2635**

The Tensor Formulation of Ferromagnetic Resonance.—J. A. Young, Jr, & E. A. Uehling. (*Phys. Rev.*, 1st May 1954, Vol. 94, No. 3, pp. 544–554.)

538.12 : 538.653.12 **2636**

Twisted Magnetic Fields in Conducting Fluids.—J. W. Dungey & R. E. Loughhead. (*Aust. J. Phys.*, March 1954, Vol. 7, No. 1, pp. 5–13.) The formation of loops in the lines of force of a twisted magnetic field confined within a cylinder of radius R is discussed by the method of normal modes. The condition obtained for loop formation is that the pitch of the twisted field be less than πR. The velocity of Alfvén waves in this model is also discussed.

538.248 **2637**

Diffusion After-Effect in Weak Alternating Fields. Validity of Rayleigh's Law.—A. Marais. (*C. R. Acad. Sci., Paris*, 3rd May 1954, Vol. 238, No. 18, pp. 1782–1784.)

538.561 : 537.56 **2638**

On the Excitation of Oscillations in a Thermal Plasma.—M. Sumi. (*J. phys. Soc. Japan*, Jan./Feb. 1954, Vol. 9, No. 1, pp. 88–92.) Plasma oscillations are considered for an arbitrary distribution of electron beams. The fundamental equations are derived assuming a weak signal and the absence of static fields. The dispersion relation derived is applied to the case of excitation of thermal plasma by an injected electron beam, and the rate of wave growth is determined. The numerical results are compared with results obtained by Merrill & Webb (*Phys. Rev.*, 15th June 1939, Vol. 55, No. 12, pp. 1191–1198).

538.566 : 535.42 **2639**

The Vector Wave Function Solution of the Diffraction of Electromagnetic Waves by Circular Disks and Apertures: Part 2—The Diffraction Problems.—C. Flammer. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, p. 543.) Correction to paper abstracted in 708 of March.

539.145 **2640**

Determination of h/e by a New Method.—F. G. Dunnington, C. L. Hemenway & J. D. Rough. (*Phys. Rev.*, 1st May 1954, Vol. 94, No. 3, pp. 592–598.) The method involves the determination of the excitation potential of He from the ground state to the lowest permitted singlet level. The value of h/e obtained is $(1{\cdot}3790 \pm 0{\cdot}0002) \times 10^{-17}$ erg.sec/e.s.u.

621.3.032.44 **2641**

Temperature Distribution in an Electrically Heated Filament.—K. S. Krishnan & S. C. Jain. (*Nature, Lond.*, 1st May 1954, Vol. 173, No. 4409, pp. 820–821.) A practical general solution is given for a filament of finite length heated in vacuo. See also 2375 of August.

537.533.8 **2642**

Physics and Applications of Secondary Electron Emission. [Book Review]—H. Bruining. Publishers: Pergamon Press, London, and McGraw-Hill, New York, 178 pp., 25s. or $5. (*J. atmos. terr. Phys.*, May 1954, Vol. 5, No. 2, pp. 114–115.) The book "covers practically everything of importance, and should serve as an admirable guide to workers in all branches of electronics".

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.7 : 550.38 **2643**

Relation between the Appearance of the Yellow Coronal Line and Geomagnetic Activity.—J. F. Denisse & P. Simon. (*C. R. Acad. Sci., Paris*, 3rd May 1954, Vol. 238, No. 18, pp. 1775–1778.) From observations of

the yellow coronal line it is possible to identify those solar-activity centres whose passage across the central meridian is accompanied by an increase of geomagnetic activity.

523.72 : 537.562 **2644**

Space-Charge-Wave Amplification in a Shock Front and the Fine Structure of Solar Radio Noise.—H. K. Sen. (*Aust. J. Phys.*, March 1954, Vol. 7, No. 1, pp. 30–35.) The dispersion equation corresponding to the non-Maxwellian velocity distribution of the particles in a shock front is derived. The roots indicate frequency bandwidths of space-charge-wave amplification decreasing with the shock strength. It is suggested, in agreement with Denisse & Rocard (1900 of 1952), that the storm bursts of narrow bandwidth originating in shock fronts constitute the elementary fine-structure components of solar radio noise bursts.

523.72 + 523.74] : 621.396.822 **2645**

Thermal Radio Emission from the Sun and the Source of Coronal Heating.—J. H. Piddington & R. D. Davies. (*Mon. Not. R. astr. Soc.*, 1953, Vol. 113, No. 5, pp. 582–596.) A statistical analysis is made of data obtained from measurements of solar radiation at frequencies between 600 and 9 400 Mc/s. The total radiation is separated into a component associated with sunspots and a 'basic' component showing no such connection. Results indicate that (*a*) sunspot radiation and the very hot regions responsible for it diminish less rapidly than the spot area and exist for a month or more after the spot has vanished; (*b*) the basic component at some frequencies is much lower than previously believed; (*c*) *S*-regions above the sunspots are the source of coronal energy, and gases spreading from them can completely replace the corona in about four days.

523.72 : 621.396.822 **2646**

Solar Radio Emissions at 4-Metres Wavelength during 1947–50 inclusive and their Relations to Solar Activity.—J. S. Hey. (*Mon. Not. R. astr. Soc.*, 1953, Vol. 113, No. 5, p. 653.) Summary of R.R.D.E. Report No. 372, Oct. 1952. Bursts at 4·1-m λ, of duration $> \frac{1}{4}$ min. and of intensity over a certain minimum, are analysed for correlation with solar flares. The medium lag of bursts behind associated flares is about a minute, but the dispersion of the time differences is such that an appreciable proportion of the bursts precede the flares. Secondary controlling factors seem to exist both for the solar phenomena and the related ionospheric phenomena. Analysis of the distribution of bursts confirms that there is a greater chance of bursts in association with flares on the eastern half of the sun's disk than on the western half.

523.72 : 621.396.822 **2647**

Observation of the Partial Solar Eclipse (February 14, 1953) at the Wavelength of 10 Centimeters (3000 Mc/s).—K. Aoki. (*Rep. Ionosphere Res. Japan*, Sept. 1953, Vol. 7, No. 3, pp. 109–115.) The diameter of the sun observed at this wavelength is 5% greater than that of the visual disk. Limb brightening is observed. Asymmetry in the eclipse curve is attributed to a local bright region round sunspots, where the values of electron density in chromosphere and corona are enhanced.

523.72 : 621.396.822 **2648**

The Distribution of Radiation across the Solar Disk at Metre Wavelengths.—P. A. O'Brien. (*Mon. Not. R. astr. Soc.*, 1953, Vol. 113, No. 5, pp. 597–612.) Measurements were made at wavelengths of 1·4, 3·7 and 7·9 m using variable-aperture interferometers and phase-switching receiver systems. The size of the emitting disk increases with increasing wavelength. Experiments with interferometers inclined at various angles to the solar axis of rotation showed the radiating shape of the sun to be elliptical; the radial distance at which the brightness temperature was reduced to half was about 25% greater at the equator than in the polar direction.

523.72 : 621.396.822 **2649**

Distribution of Radio-Frequency Brightness across the Solar Disk and the Derivation of a Model Corona.—P. A. O'Brien & C. J. Bell. (*Nature, Lond.*, 30th Jan. 1954, Vol. 173, No. 4396, p. 219.) The derivation of a model consistent with observations previously reported (2648 above) is discussed.

523.72 : 621.396.822.029.62 **2650**

Solar Radio Asymmetry at 4-Metres Wavelength.—J. S. Hey & V. A. Hughes. (*Nature, Lond.*, 24th April 1954, Vol. 173, No. 4408, p. 771.) The greater frequency of observation of solar bursts at 4·1 m in association with flares on the eastern half of the sun's disk [1368 of 1949 (Hey et al.)] may be due to absorption of bursts from the western half in ionized streams. This would account for the lack of evidence of asymmetry at 1·5 m, for which wavelength absorption is much less. An analysis of this asymmetry with reference to geomagnetic activity is being made.

523.852 : 621.396.822 **2651**

Intensities of Discrete Radio Sources in Cygnus and Cassiopeia at 22.6 Mc/s.—J. S. Hey & V. A. Hughes. (*Nature, Lond.*, 1st May 1954, Vol. 173, No. 4409, pp. 819–820.) Measured intensities are $9{\cdot}4 \times 10^{-22}$ and $4{\cdot}6 \times 10^{-22}$ W/m^2.(c/s) for the sources in Cassiopeia and Cygnus respectively. Comparison with intensities measured previously at higher frequencies indicates that in the spectrum of the Cassiopeia source intensity is proportional to (frequency)$^{1\cdot2}$, the variation in the Cygnus source being similar except at lower frequencies, where the rate of increase of intensity is reduced.

523.852.3 : 621.396.822 **2652**

Radio Emission from the Perseus Cluster.—J. E. Baldwin & B. Elsmore. (*Nature, Lond.*, 1st May 1954, Vol. 173, No. 4409, p. 818.) Results of observations at 3·7-m λ, using radio-interferometer apertures of 14 λ and 157 λ, provide confirmation for the identification of the radio source with *NGC* 1275.

523.854 : 621.396.822 **2653**

Galactic Radiation at Radio Frequencies: Part 7—Discrete Sources with Large Angular Widths.—J. G. Bolton, K. C. Westfold, G. J. Stanley & O. B. Slee. (*Aust. J. Phys.*, March 1954, Vol. 7, No. 1, pp. 96–109.) Observations with a 72-ft reflector at a frequency of 150 Mc/s, with the sea interferometer at 110 Mc/s, and with the azimuth interferometer at 100 Mc/s, revealed the existence of a number of sources of angular width $>1°$. The observations are described and discussed; the limitations of interference techniques are summarized. Part 6 : 1756 of June (Bolton, Slee & Stanley).

523.854 : 621.396.822 **2654**

Galactic Radiation at Radio Frequencies: Part 8—Discrete Sources at 100 Mc/s between Declinations +50° and −50°.—J. G. Bolton, G. J. Stanley & O. B. Slee. (*Aust. J. Phys.*, March 1954, Vol. 7, No. 1, pp. 110–129.) One hundred and four discrete sources have been found. Individual sources are compared in position and flux density with those of previous surveys. The observed distribution of sources is discussed. Several identifications with visible sources are suggested. Part 7: 2653 above.

523.854 : 621.396.822 **2655**

A Comparison of the Intensities of Cosmic Noise observed at 18.3 Mc/s and at 100 Mc/s.—C. A. Shain. (*Aust. J. Phys.*, March 1954, Vol. 7, No. 1, pp. 150–164.) The

principal conclusion of this comparison is that the background radiation cannot be made up of the radiation from sources of the type observed so far, although a small polar component may be due to the extragalactic sources. Absorption in interstellar gas has a considerable effect on the intensity variations of background radiation with direction observed at 18·3 Mc/s.

523.854 : 621.396.822 : 550.510.535 **2656**

Observations of the General Background and Discrete Sources of 18.3-Mc/s Cosmic Noise.—C. A. Shain & C. S. Higgins. (*Aust. J. Phys.*, March 1954, Vol. 7, No. 1, pp. 130–149.) A survey of a broad strip of sky, centred on declination $-32°$, has been made using an aerial with beam width to half power of 17°. Previous results concerning the background distribution of brightness have been confirmed and 37 discrete sources have been detected. The distribution of these sources is shown. No correlation was found between the occurrence of scintillations and published ionospheric data, but the observations are consistent with an origin of scintillations in irregularities of dimensions about 4 km at a height of about 500 km.

523.854 : 621.396.822.029.62 **2657**

Galactic Radio Sources of Large Angular Diameter.—R. H. Brown, H. P. Palmer & A. R. Thompson. (*Nature, Lond.*, 15th May 1954, Vol. 173, No. 4411, pp. 945–946.) Preliminary results are given of measurements of the apparent angular width of sources previously observed [1408 of May (Brown & Hazard)].

523.854.22 : 621.396.822 : 621.396.677.3 **2658**

Wide-Band Radio Interferometer.—V. V. Vitkevich. (*C. R. Acad. Sci. U.R.S.S.*, 21st Aug. 1953, Vol. 91, No. 6, pp. 1301–1303. In Russian.) The use of a wide-band amplifier, with the frequency characteristic given, in conjunction with an aerial system consisting of two or four aerials in line or 16 aerials arranged symmetrically in a square, results in very high resolution. In the example quoted radio sources separated by an angle of 15′ can be resolved. The theory of the interferometer is given and the general form of the directional characteristic is shown.

550.384 **2659**

Geomagnetic Bay Disturbances and their Nonuniform Induced Components within the Earth.—H. Wiese. (*Z. Met.*, Feb./March 1954, Vol. 8, Nos. 2/3, pp. 77–79.) The bay disturbance is considered as the field of a travelling dipole in the auroral zone, the direction of travel depending on time of day. The induced component within the earth exhibits local variations depending on the conductivity; a 'dynamic' anomaly is observed in an area in Central Europe, the vertical component being a maximum in the north and a minimum in the south when the ionosphere current is directed southward.

550.385/.386 : 525.233 **2660**

The Use of Earth-Potential Measurements for Magnetic- and Ionospheric-Storm Indication.—A. H. De Voogt. (*J. atmos. terr. Phys.*, May 1954, Vol. 5, No. 2, pp. 108–110.) Using the underground telephone cable system, potentials are measured in directions as nearly parallel and perpendicular to the magnetic meridian as possible. Each of the cable circuits is over 100 km long and is provided with several earthing points at the ends. The recorders are housed in the control room of the PTT station Radio-Kootwijk.

551.5 : 621.396.11.029.6 : 061.3 **2661**

Radio-Meteorology: Conference in Texas.—Saxton. (See 2751.)

551.510.3 : 535.325 **2662**

A Preliminary Survey of Tropospheric Refractive Index Measurements for U.S. Interior and Coastal Regions.—C. M. Crain, J. R. Gerhardt & C. E. Williams. (*Trans. Inst. Radio Engrs*, Jan. 1954, Vol. AP-2, No. 1, pp. 15–22.) Results of some 700 recordings made between July and December 1952 using airborne refractometers at heights up to 25 000 ft are summarized. The existence of large differences in refractive index near certain cloud boundaries is confirmed. See also 1759 of June (Crain et al.).

551.510.535 **2663**

Atmospheric Space Charge.—W. D. Parkinson : J. A. Chalmers. (*J. atmos. terr. Phys.*, May 1954, Vol. 5, No. 2, pp. 106–108.) Comment on 131 of January and author's reply.

551.510.535 **2664**

The Evaluation of Ionospheric Observations.—G. Grawert & H. Lassen. (*Z. angew. Phys.*, March 1954, Vol. 6, No. 3, pp. 136–143.) A critical discussion of the various methods used in calculating the height distribution of the charge-carrier concentration and other parameters, from experimentally determined $h'f$ curves. The corrections and the estimation of errors in the calculated F-layer height in the presence of an E layer and the effect of neglecting the E layer in this calculation are discussed. An approximate method is indicated for taking the geomagnetic field into account.

551.510.535 **2665**

Semidiurnal Currents and Electron Drifts in the Ionosphere.—J. A. Fejer. (*J. atmos. terr. Phys.*, May 1954, Vol. 5, No. 2, p. 103.) Correction to paper abstracted in 1420 of May.

551.510.535 **2666**

A Subsidiary Layer in the E Region of the Ionosphere.—R. Naismith. (*J. atmos. terr. Phys.*, May 1954, Vol. 5, No. 2, pp. 73–82.) Echoes from sporadic-E can be distinguished from those from a layer at 90–100 km height. It is suggested that the ionization in this layer results from the impact of meteors on the atmosphere and that it may therefore be called the meteoric E layer. The distinctive properties may be used to extend the use of the ionosphere for intermediate-distance radio communication.

551.510.535 **2667**

Origin of the Ionospheric E Layer.—K. Rawer & É. Argence. (*Phys. Rev.*, 15th April 1954, Vol. 94, No. 2, pp. 253–256.) Critical discussion of theories of formation based on (*a*) ionization of O_2 by ultraviolet light, and (*b*) ionization by solar soft X-rays. The intensity of incoming radiation seems insufficient, in view of absorption, in case (*a*), but, from Elwert's computations (*Z. Naturf.*, 1952, Vol. 7a, No. 2, pp. 202–204), sufficient in case (*b*). Provided dissociation of O_2 occurs in a high transition layer of considerable thickness, both processes may be involved, but process (*b*) seems the more important.

551.510.535 **2668**

Multiple Stratification of the F Layer at Ibadan.—N. J. Skinner, R. A. Brown & R. W. Wright. (*J. atmos. terr. Phys.*, May 1954, Vol. 5, No. 2, pp. 92–100.) Observations made during the period December 1951–January 1953 are reported. In the F_2 layer there is a maximum occurrence of ridges around 1000 and 1500 hours, the first maximum being the more pronounced. A seasonal variation is found, a maximum number of ridges being observed when the midday minimum of f_0F_2 occurs early in the day. A lunar semidiurnal variation is detectable

during the morning hours. Formation of ridges is also observed in the F_1 layer, but there is little relation to those of the F_2 layer. Possible phases of vertical drift velocities that could explain the observations are discussed.

551.510.535 **2669**

On the F_2 Layer Distribution in Polar Region.—T. Obayashi. (*Rep. Ionosphere Res. Japan*, Sept. 1953, Vol. 7, No. 3, pp. 118–121.) Results of an analysis of monthly mean values of f_0F_2, $h'F_2$, f_0F_1 and f_0E for March 1951 are summarized. In a region along the auroral zone where the $h'F_2$ values are anomalously high, maxima occur at noon and midnight, and the region rotates round the earth with the sun. The increase of apparent height of the F_2 layer is due to wave retardation in the F_1 layer during daytime in high latitudes.

551.510.535 **2670**

A Theory of Distribution and Variation of the Ionospheric F_2 Layers.—K. Maeda. (*Rep. Ionosphere Res. Japan*, Sept. 1953, Vol. 7, No. 3, pp. 81–107.) "A brief description is first given on the results of our recent studies, which have led to the conclusions of inhibition of vertical ionospheric current, enhancement of conductivity, dynamo current and vertical drift of charged particles near the geomagnetic equator and suppression of daytime electron density of F_2 layer caused by an upward drift of electrons. The treatment is extended to the case of ionospheric storm accompanied with geomagnetic storm. The comparison of the theoretical and observational results is made for the cases of undisturbed as well as disturbed states of F_2 layer. The agreement is generally good for undisturbed case, but not quite satisfactory for disturbed case. The mechanism of dynamo in the ionosphere is discussed and a hypothetical consideration concerning a wind system during a storm is given."

551.510.535 : 523.3 : 621.396.11 **2671**

Lunar Radio Echoes and the Faraday Effect in the Ionosphere.—Murray & Hargreaves. (See 2748.)

551.510.535 : 523.75 **2672**

The Enhancement of Ionospheric Ionization during Solar Flares.—A. P. Mitra & R. E. Jones. (*J. atmos. terr. Phys.*, May 1954, Vol. 5, No. 2, pp. 104–106.) Study of the recombination coefficient in the lower ionosphere, based on the decay of sudden phase anomalies at 16 kc/s and on sudden enhancements of atmospherics, gives values much smaller than those reported by Bates & Seaton (1407 of 1950). Measurements of the delay between the time of maximum flare and the times of maxima of sudden phase anomalies and sudden enhancements of atmospherics also suggest smaller values. These results indicate that for any height the value of the recombination coefficient remains unaltered during a sudden ionospheric disturbance and that the sudden increase in electron concentration is due to an increase in the rate of electron production in the layer.

551.510.535 : 523.78 **2673**

Corpuscular Eclipse in the F_2 Layer and its Association with Solar Flares and M-Regions.—P. K. S. Gupta & S. N. Mitra. (*Nature, Lond.*, 1st May 1954, Vol. 173, No. 4409, pp. 814–816.) A survey of present knowledge on solar sources of corpuscular streams and on corpuscular velocities. The drop in the F_2-layer ion density occurring approximately five hours before the maximum of the optical solar eclipse is briefly discussed and it is suggested that in future F_2-layer observations should commence at least seven hours before the moment of totality.

551.510.535 : 621.396.11.029.53 **2674**

High Multiple Radio Reflections from the F_2 Layer of the Ionosphere at Brisbane.—Baird. (See 2750.)

551.593 **2675**

The Effect of Rayleigh Scattering and Ground Reflection upon the Determination of the Height of the Night Airglow.—E. V. Ashburn. (*J. atmos. terr. Phys.*, May 1954, Vol. 5, No. 2, pp. 83–91.)

LOCATION AND AIDS TO NAVIGATION

621.396.9 : 621.396.621 **2676**

Aircraft Receiver for VOR-ILS and Communications.—G. W. Gray. (*Electronics*, June 1954, Vol. 27, No. 6, pp. 180–184.) Description of complete navigation and communication equipment. C.r.o. presentation of omnirange signal and c.r. indicator for instrument landing system right-left signals are provided. High sensitivity is achieved in the omnirange receiver by using the extremely low bandwidth of about 6 c/s in order to reduce noise. Special arrangements are made to avoid errors due to possible phase shifts resulting from use of this narrow band.

621.396.93 + 621.398] : 621.396.665 **2677**

Sequentially Gated Automatic Gain Control.—M. Eliason. (*Electronics*, June 1954, Vol. 27, No. 6, pp. 186–188.) The arrangement described, which is applicable to navigation and telemetry systems, supplies a control voltage which holds receiver output constant within $\pm$ 1 db when pulse signals are received from two or more transmitters in turn on the same frequency but with widely different strengths. Separate a.g.c. circuits corresponding to each transmitter are provided and are gated sequentially in synchronism with the transmitters.

621.396.933 : 621.396.621 **2678**

Airborne Loran Receiver — the AN/APN-70.—R. R. Freas. (*Trans. Inst. Radio Engrs*, March 1954, Vol. ANE-1, No. 1, pp. 17–25.) The AN/APN-70 equipment was designed primarily for improved operating convenience and reliability as compared with older types. Improvements introduced include (*a*) time-difference information presented directly on counter dials, (*b*) possibility of operation on the new l.f. channels, giving instantaneous indication of position, (*c*) a.f.c. of the timing oscillator, (*d*) independent gain control for signals from each ground station, (*e*) high-sensitivity aerial coupler, and (*f*) all circuits and components selected for their reliability.

621.396.96 : 621.316.726 **2679**

Automatic Tuning for Primary Radar.—S. Ratcliffe. (*Wireless Engr*, May–July 1954, Vol. 31, Nos. 5–7, pp. 122–131, 153–165 & 187–192.) Research into the basic techniques of automatic frequency correction is reported and design principles are discussed with particular attention to the requirements of airborne microwave radar equipment. For convenience, the frequency control is applied to the receiver rather than the transmitter, maintenance of the desired i.f. being more important than the absolute frequency. The frequency variations to be controlled may be either long-term, such as those due to changes in ambient temperature or pressure, or short-term, such as variations in magnetron frequency due to changes in the matching during rotation of the scanner. Receiver bandwidth and sensitivity are considered in relation to the conditions under which it may be economical to use an a.f.c. system with a response rapid enough to deal with scanner pulling. Circuits with the smallest possible number of pre-set adjustments should be used; adoption of a wide-band a.f.c. system is advantageous from this point of view.

621.396.96 : 621.396.676 **2680**

U.H.F. Omnidirectional Antenna Systems for Large Aircraft.—Sichak & Nail. (See 2568.)

621.396.962.3 **2681**

Improved Demodulator for Radar Ranging.—C. E. Goodell. (*Electronics*, June 1954, Vol. 27, No. 6, pp. 170–171.) Gaps due to loss of echo pulses as a result of scattering, absorption, etc. are filled in by pulses generated in the demodulator. Range errors are thus reduced.

621.396.965 **2682**

Antenna Scan Considerations.—D. Levine. (*Trans. Inst. Radio Engrs*, March 1954, Vol. ANE-1, No. 1, pp. 26–40.) Three types of scan are considered, (*a*) the spiral scan, (*b*) the simple conical scan, (*c*) sector scanning, the aerial having simple harmonic motion. In general a harmonic type of sector scan is to be preferred to a uniformly rotating system of n aerials, provided the total angle of scan is $< 229{\cdot}2^\circ/n$. A figure of merit for a sector scan having nonharmonic motion is also derived.

MATERIALS AND SUBSIDIARY TECHNIQUES

531.788.7 **2683**

Pressure Measurement with the Pirani Gauge.—K. D. Mielenz. (*Z. angew. Phys.*, March 1954, Vol. 6, No. 3, pp. 101–104.) The design of a Pirani gauge is discussed on the basis of expressions for the thermal losses of the heater wire and for the sensitivity of the gauge when used in a Wheatstone bridge. For maximum sensitivity the requirements include a galvanometer with high voltage sensitivity, low-resistance bridge arms, a low external temperature obtained by immersing the gauge in liquid air, and low heater-wire temperature obtained by using high-resistivity wire. These requirements were confirmed experimentally by measurements at pressures down to $1{\cdot}7 \times 10^{-5}$ Torr.

531.788.7 **2684**

A Simple Thermionic Vacuum Gauge.—G. K. T. Conn & H. N. Daglish. (*J. sci. Instrum.*, March 1954, Vol. 31, No. 3, pp. 95–96.) The gauge described is similar in essentials to that of Bayard & Alpert (2785 of 1950), but is much easier to construct.

533.583 **2685**

Influence of Electronic Impact on the Rate of Sorption of Gases on to Getter Materials.—S. Wagener. (*Nature, Lond.*, 10th April 1954, Vol. 173, No. 4406, pp. 684–685.) Experiments made with Ba and Mg getters, using a Knudsen gauge and a special diode to produce electron impact, indicate that the introduction of the latter does not materially affect the gettering rate.

535.215 : 538.632 : 546.311.12 **2686**

Electronic Hall Effect in the Alkali Halides.—A. G. Redfield. (*Phys. Rev.*, 1st May 1954, Vol. 94, No. 3, pp. 537–540.) The Hall mobility of electrons in NaCl, KCl, KBr and KI was measured using the technique described in 2687 below.

535.215 : 538.632 : 549.211 **2687**

Electronic Hall Effect in Diamond.—A. G. Redfield. (*Phys. Rev.*, 1st May 1954, Vol. 94, No. 3, pp. 526–537.) The crystal is placed between two glass plates coated with a very thin semiconducting film. An electrometer is connected to the upper plate and the potential of the lower plate is varied. To make a measurement the magnetic field is applied in opposite directions alternately, the crystal being illuminated and the potentiometer adjusted to give zero deflection on the electrometer for each direction. The Hall angle can be obtained approximately from the measured voltage change and the electrode geometry. Sources of error and corrections are considered in detail. Electronic mobility varies as $T^{-3/2}$ and is about 1 800 cm/s per V/cm at 300°K, the corresponding figures for holes being $T^{-3/2}$ and 1 200 cm/s per V/cm.

535.215 : 546.289 **2688**

Photoconductivity in Gold-Germanium Alloys.—R. Newman. (*Phys. Rev.*, 15th April 1954, Vol. 94, No. 2, pp. 278–285.) Photoconductivity in n- and p-type gold-doped Ge was investigated at 77° and 22°K. The low-energy thresholds for impurity photoconduction are compatible with the activation energies measured by electrical methods. In some n-type specimens quenching effects were observed, with prominent quench bands at 0·8 and 0·66 eV. Characteristics of the quenching were measured as functions of light intensity, applied voltage and temperature. No complete explanation is offered.

535.215 : 546.431-31 : 539.234 **2689**

External Photoemission of Thin Films Deposited by Evaporation from Barium Oxide.—S. Narita. (*J. phys. Soc. Japan*, Jan./Feb. 1954, Vol. 9, No. 1, pp. 22–27.) Experimental investigation of films deposited on Mo and on Ta surfaces is reported. The variation of the energy distribution of the photoelectric emission and the thermionic work function with layer thickness is shown graphically and the change from metallic-type photoelectric emission, expressed by Fowler's equation, to the semiconductor type is noted. The dependence of photoelectric emission on the plane of polarization of the incident light is also shown graphically.

535.37 **2690**

Comparative Measurements of Electron-Excited Luminescent Screens for Front Viewing and for Back Viewing.—B. Deubner & F. Hieber. (*Z. angew. Phys.*, March 1954, Vol. 6, No. 3, pp. 112–115.) Light-yield measurements were made on Cu-activated ZnS screens excited by a 40-kV electron beam incident at 45°. Screens of various thicknesses were used, with and without an Al base. Maximum yields in transmission-type screens, equal to those of front-viewing types, were obtained using an Al layer separated by collodion from the luminescent material. The resolution at various grain sizes was also measured. The results are shown graphically.

535.37 : 546.817.221 **2691**

Photoluminescence of PbS in the Infrared Region of the Spectrum.—L. N. Galkin & N. V. Korolev. (*C. R. Acad. Sci. U.R.S.S.*, 21st Sept. 1953, Vol. 92, No. 3, pp. 529–530. In Russian.) Brief account of method and results of an investigation of photoluminescence in the region 2–3·5 μ.

537.226 **2692**

Photodielectric Effect [dielectric loss change].—J. Roux. (*J. Phys. Radium*, March 1954, Vol. 15, No. 3, pp. 176–188.) A critical survey of work done on this subject. Most crystalline phosphors exhibit the effect, the magnitude of which depends largely on the phosphor type and preparation, and is greatly influenced by the nature and intensity of the excitation radiation, and by the intensity and frequency of the electric field applied to measure the capacitance of the material. A decay in the effect closely following the decay in phosphorescence is observed. Some relation between phosphorescence and dielectric loss change exists, but its exact nature has not been established.

537.226 : 538.56.029.4/.6 **2693**

The Radio Spectrum and Structure of Solids: Part 1—Debye Absorption in Solids, at Frequencies within the Radio Spectrum, and Lattice Defects.—M. Freymann & R. Freymann. (*J. Phys. Radium*, March 1953, Vol. 14,

No. 3, pp. 203–211.) In the study of solids by examination of their dielectric properties, two types of dipole must be distinguished, (*a*) dipoles associated with orientation of molecules or groups of atoms, and (*b*) dipoles associated with lattice defects. Experimental methods used to measure absorption at frequencies between 300 kc/s and 300 kMc/s are surveyed.

537.226 : 538.56.029.4/.6 **2694**

The Radio Spectrum and Structure of Solids: Part 2—Debye Absorption in Water in the Free and in the "Bound" State.—M. Freymann & R. Freymann. (*J. Phys. Radium*, March 1954, Vol. 15, No. 3, pp. 165–175.) Critical examination of experimental data with a view to extending the theory developed in part 1 (2693 above) to ionic crystals and semiconductors.

537.311.3 : 539.23 **2695**

Tentative Explanation of the Conduction Mechanism of Thin Granular Metal Layers.—N. Nifontoff. (*C. R. Acad. Sci., Paris*, 10th May 1954, Vol. 238, No. 19, pp. 1870–1872.) Experimental results on the variation of the resistance of granular metal layers can be explained by assuming the existence of a more or less continuous impurity-rich semiconductor layer between the grains. An electron passing from one grain to another then crosses two metal-semiconductor boundaries, the resistance being localized almost entirely at the reverse boundary.

537.311.3 : 539.23 **2696**

High-Frequency Resistance of Thin Films.—R. Broudy & H. Levinstein. (*Phys. Rev.*, 15th April 1954, Vol. 94, No. 2, pp. 285–289.) Measurements on evaporated Ge, Rh and Au films show that for uniform films the decrease of resistance with frequency is due to simple self-capacitance. When the ratio of the a.c. and d.c. resistances is plotted against the product of frequency and d.c. resistance, data for uniform films of each material fall on a single curve. The presence of non-uniformities in the film produces an additional decrease of resistance with frequency corresponding to the degree of variation in resistance per unit length.

537.311.3 : 539.23 : 621.383.4 **2697**

High-Frequency Resistance of Photoconducting Films.—R. Broudy & H. Levinstein. (*Phys. Rev.*, 15th April 1954, Vol. 94, No. 2, pp. 290–292.) PbTe photocells were prepared by evaporation under controlled conditions, and the resistance/frequency characteristic measured for various types of illumination. The degree of irregularity in response correlated with the degree of nonuniformity of the film, the nonuniformity detected decreasing on exposure to light.

537.311.33 **2698**

Semiconducting Compounds and the Scale of Electronegativities.—C. H. L. Goodman. (*Proc. phys. Soc.*, 1st March 1954, Vol. 67, No. 411B, pp. 258–259.) In considering the relation between the ionic component of bonding and energy gap, suggested by Welker (1798 of June) a useful guide to the ionicity of a binary compound can be obtained from the electronegativity difference of its elements. Correlation between energy gap and electronegativity difference exists for certain compounds between groups III and V and between groups II and VI of the periodic table. Mobility values for HgSe, InSb and HgTe support this hypothesis. HgSe may be of particular interest for semiconducting devices such as crystal triodes.

537.311.33 : 546.23 **2699**

Experimental and Theoretical Investigation of the Isothermal and the Adiabatic Hall Effect in Se.—R. Diestel. (*Z. Naturf.*, Aug. 1953, Vol. 8a, No. 8, pp. 453–457.) The isothermal and adiabatic Hall coefficients are calculated for a *p*-type semiconductor. The difference between the two values decreases rapidly with increasing thermal conductivity of the lattice, but even for substances, such as Se, with low thermal conductivity the difference amounts to only about 1%. This result is confirmed by measurements on Se.

537.311.33 : 546.23 **2700**

Hole Conduction in Crystalline Selenium.—W. Schottky. (*Z. Naturf.*, Aug. 1953, Vol. 8a, No. 8, pp. 457–459.) Results obtained by Diestel (2699 above) indicate that the value of the thermoelectric force for Se found from direct measurement is more than twice the value found from Hall-effect measurements. It is tentatively suggested that the discrepancy can be explained by assuming an impurity-band conduction mechanism rather than conduction by free holes.

537.311.33 : [546.24 + 546.3-1-24-23 **2701**

Electrical Properties of Pure Tellurium and Tellurium-Selenium Alloys.—A. Nussbaum. (*Phys. Rev.*, 15th April 1954, Vol. 94, No. 2, pp. 337–342.) Measurements of resistivity and Hall coefficient for pure single-crystal Te and for six different single-crystal TeSe alloys with a maximum Se content of about 15% by weight were made over the temperature range 90°–550°K. An increase in the forbidden-band width and a lowering of the upper anomalous Hall-coefficient reversal temperature with increased Se content was observed.

537.311.33 : 546.24.03 **2702**

Electrical Properties of Tellurium Crystals at Very Low Temperatures.—T. Fukuroi, S. Tanuma & Y. Muto. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser.A*, Feb. 1954, Vol. 6, No. 1, pp. 18–29.) The electrical conductivity, the Hall effect and the magnetoresistance effect were investigated in the temperature range from 1·7°K to room temperature, using both pure single crystals of Te and Te crystals including 0·01% Sn. The results are tabulated and shown graphically.

537.311.33 : 546.28 **2703**

Hall Mobility of Electrons and Holes in Silicon.—P. P. Debye & T. Kohane. (*Phys. Rev.*, 1st May 1954, Vol. 94, No. 3, pp. 724–725.) Mobility/resistivity curves are shown, obtained at 295°K on single-crystal specimens of *n* and *p* type ranging in resistivity from 0·1 to 94 Ω.cm and from 0·025 to 110 Ω.cm respectively. For the highest resistivity values the mobility for electrons is about 1 900 cm/s per V/cm and for holes 425 cm/s per V/cm.

537.311.33 : 546.289 **2704**

Resistivity Striations in Germanium Crystals.—P. R. Camp. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, pp. 459–463.) Variations in conductivity may be made visible by electroplating, with $CuSO_4$ as electrolyte, since more copper will be deposited on regions having low resistivity. Pulsed voltage is applied. Maximum visual contrast is obtained by suitably adjusting the resistivity of the electrolyte, the magnitude and duration of the pulses and the pulse repetition frequency.

537.311.33 : 546.289 : 621.396.822 **2705**

Noise in Germanium Filaments at Very Low Frequencies.—B. V. Rollin & I. M. Templeton. (*Proc. phys. Soc.*, 1st March 1954, Vol. 67, No. 411B, p. 271.) Measurements using the technique previously proposed (2039 of 1953) are reported.

537.311.33 : 546.482.21.03 : 539.234 **2706**

The Optical and Electrical Properties of Cadmium Sulphide Films.—G. Kuwabara. (*J. phys. Soc. Japan*, Jan./Feb. 1954, Vol. 9, No. 1, pp. 97–102.) An experi-

mental investigation of evaporated films shows that the optical properties are reproducible and similar to those of CdS single crystals, while the electrical properties depend on the conditions of evaporation and after-treatment. A close correlation between dark conductivity and photosensitivity was found. The results are shown graphically and are discussed.

537.311.33 : 546.682.86 **2707**

Electrical Properties of InSb.—H. Weiss. (*Z. Naturf.*, Aug. 1953, Vol. 8a, No. 8, pp. 463–469.) Continuation of work described by Welker (1798 of June). Measurements of conductivity, Hall effect and magnetoresistance are reported. Both *n*- and *p*-type samples were observed, depending on the impurity concentration. At room temperature, the highest value of electron mobility found was 41 000 cm/s per V/cm, and the greatest variation of resistance in a magnetic field of 10 000 gauss amounted to 150%.

537.311.33 : 548.5 **2708**

Crystal Growth by the Tip Fusion Method.—P. H. Keck, S. B. Levin, J. Broder & R. Lieberman. (*Rev. sci. Instrum.*, March 1954, Vol. 25, No. 3, pp. 298–299.) The main feature of the method described is the fusion of the tip of the boule into a sessile drop by means of a tungsten ring heated by h.f. induction. A continuous stream of powder is supplied from above, and the growing crystal is withdrawn slowly downward from the hot zone. Polycrystalline Si boules about 1 in. long and $\frac{1}{4}$ in. in diameter were grown at a rate of 1 in. per hour.

538.221 : 539.234 **2709**

The Magnetization of Very Thin Iron Films.—W. Reincke. (*Z. Phys.*, 15th March 1954, Vol. 137, No. 2, pp. 169–174.) Iron films evaporated on to glass plates were suspended by spun thread in a magnetic field and set in torsional oscillation. Susceptibility was calculated from the oscillation period, the field strength, the moment of inertia of the plates, and the volume of the film. Film thickness d was measured optically. Results are in agreement with calculations of Klein & Smith (1675 of 1951). Magnetization starts to decrease at value $d = 125$ Å, disappearing at $d = 11$ Å. For $d < 100$ Å saturation is reached at much lower field strengths than are required for thicker films.

538.221 : 621.318.134 **2710**

Magnetic-Dispersion Spectrum of a Ni-Zn Ferrite.—I. Lucas. (*Z. angew. Phys.*, March 1954, Vol. 6, No. 3, pp. 127–130.) The decrease of permeability with increasing frequency is explained on the basis of superposition of sharp spin-resonances. From the distribution function of characteristic frequencies, approximate formulae are derived for the observed relation between the static susceptibility and the lower limiting characteristic frequency, the dispersion of the loss factor at low frequencies and the decrease of permeability at high frequencies. The width of the dispersion spectrum is determined by the internal demagnetization at the Weiss-domain boundaries.

538.221 : 621.318.134 **2711**

Magnetic Behaviour of some Ferrites.—K. F. Niessen. (*Physica*, Nov. 1953, Vol. 19, No. 11, pp. 1127–1132.) Calculations based on a series of measurements on mixed crystals of nickel ferrite and nickel titanate, $Fe_{2-2a}Ni_{1-a}Ti_aO_4$, with $0<a<0{\cdot}5$, show that the Ti appears to be distributed statistically amongst the tetrahedral and octahedral sites of the spinel when $a \ll 1$ but appears to show preference for the tetrahedral sites as a increases.

538.221 : 621.318.134.029.64/.65 **2712**

Resonance Absorption in Ferrites.—T. Okamura. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, Feb. 1954, Vol. 6, No. 1, pp. 89–108.) An experimental investigation over the frequency range 9·45 kMc/s–47 kMc/s at room temperature and at −195°C is reported. The real spectroscopic splitting factor, g, which is independent of frequency and temperature, was determined for ferrites of Ni, Mn, Ni-Zn and Mn-Zn by using the corrected Kittel resonance formula. A semi-empirical formula for the internal field is given. Results for true g-values and the internal fields are tabulated and the latter compared with calculated values.

538.221 : 621.318.134.029.64/.65 **2713**

The Effect of the Anisotropy and the Relaxation Phenomena on the Shift of Ferromagnetic Resonance in Polycrystalline Ferrites.—M. Date. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, Feb. 1954, Vol. 6, No. 1, pp. 109–113.)

548.55 : 546.78 **2714**

Thermionic and Surface Properties of Tungsten Crystals.—G. F. Smith. (*Phys. Rev.*, 15th April 1954, Vol. 94, No. 2, pp. 295–308.) The relation between the production process for single crystals and types of surface structure was studied, and thermionic constants were determined for various crystallographic directions.

548.55 : 546.833 **2715**

Growth and Surface Properties of Tantalum Crystals.—M. H. Nichols. (*Phys. Rev.*, 15th April 1954, Vol. 94, No. 2, pp. 309–313.) A study of Ta on the lines of 2714 above.

621.315.612.4 : 546.431.824-31 **2716**

Anomalous Temperature Coefficient of Permittivity in Barium Titanate.—K. W. Plessner & K. A. Cook. (*Nature, Lond.*, 10th April 1954, Vol. 173, No. 4406, pp. 682–683.) A negative temperature coefficient of permittivity was observed in a very pure ceramic $BaTiO_3$ sample subjected to alternations of temperature around the Curie point. The anomaly is related to the co-existence of the cubic and tetragonal phases. The observations support the view that the transition at about 120°C is a first-order transition.

MATHEMATICS

519.2 **2717**

Statistics of a Population with Creation and Recombination Dependent on Existing Numbers.—D. A. Bell. (*Proc. phys. Soc.*, 1st March 1954, Vol. 67, No. 411B, pp. 227–231.) "Populations liable to loss by recombination are likely to have a rate of loss proportional to the square of the number present; and the distribution function is then related either to a Bessel function or to a Laguerre polynomial, according as the rate of creation is either constant or dependent on the complement of the number already present." Statistics of the number of particles present are then no longer the same as those of the density fluctuations in a perfect gas.

MEASUREMENTS AND TEST GEAR

621.3.014(083.74) **2718**

Preliminary Development of a Magnettor Current Standard.—E. P. Felch & J. L. Potter. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 524–531.)

621.316.84(083.74) **2719**

The Behaviour of Gold-Chromium Standard Resistors under Load.—A. Schulze & D. Bender. (*Z. angew. Phys.*, March 1954, Vol. 6, No. 3, pp. 132–136.) The effect of loads up to 1 W on the resistance of 1-Ω, 10-Ω and 100-Ω resistors was measured; the results are tabulated.

621.317.335 : 537.228.1 **2720**

Methods for Measuring Piezoelectric, Elastic, and Dielectric Coefficients of Crystals and Ceramics.—W. P. Mason & H. Jaffe. (*Proc. Inst. Radio Engrs*, June 1954, Vol. 42, No. 6, pp. 921–930.) Various methods are reviewed, with a view to standardization. For investigating small specimens, the click-oscillator method and the balanced-capacitance-bridge methods are suitable. The dynamic method involving measurements of resonance and antiresonance frequencies, low-frequency capacitance, and resonance resistance is recommended as simplest and most accurate for large-size specimens with high values of Q/r, where r is the ratio of the crystal capacitances. Quasi-static methods are useful for crystals having a low value of Q/r, for determining the sign of the piezoelectric coefficients, and for production checks. Hydrostatic methods are useful for complicated crystals and for measuring a sum of two of the coefficients of electrostrictive ceramics.

621.317.373 : 621.317.755 **2721**

Cathode-Ray-Tube Protractor or Synchroscope.—H. Sohon. (*Elect. Engng, N.Y.*, March 1954, Vol. 73, No. 3, pp. 220–221.) Description of a bridge-type *RC* phase-shifting network for use with a c.r.o. for measurement of the phase difference between two signals. The angle is indicated on the calibrated c.r. tube screen by the major axis of the elliptical trace.

621.375.3.015.3.001.4 **2722**

A Transient Analyzer for Magnetic Amplifiers.—E. J. Smith. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 461–465. Digest, *Elect. Engng, N.Y.*, March 1954, Vol. 73, No. 3, p. 218.) The response time of the magnetic amplifier is obtained directly by comparing the saturation phase angle with a reference phase angle marked by a train of pulses.

621.317.41 **2723**

An Automatically Recording Magnetic Balance.—T. Hirone, S. Maeda & N. Tsuya. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, Feb. 1954, Vol. 6, No. 1, pp. 67–76.) Description of instrument for determining the magnetization/temperature characteristics of small samples over the range from the temperature of liquid He to $\sim 1\,000$°C.

621.317.411 + 621.317.335.3] : 621.318 **2724**

Theory of Measurement of μ and ϵ of Semiconducting Ferromagnetics.—K. M. Polivanov. (*C. R. Acad. Sci. U.R.S.S.*, 1st March 1954, Vol. 95, No. 1, pp. 61–64. In Russian.) The method used for determining the complex electrical impedances of a specimen in an electric circuit or a magnetic field is analogous to the open- and short-circuit method of determining characteristic impedance and propagation constant of a long line. Expressions for the complex impedances in terms of the complex values of μ and ϵ are given. The advantages of using rod or ring specimens in a coaxial line are noted.

621.317.7 : 621.396.822 : 621.397.828 **2725**

Impulse Noise Generators.—M. V. Callendar. (*Electronic Engng*, May 1954, Vol. 26, No. 315, pp. 200–203.) Two generators are described, suitable for testing sound or vision receivers for their response to impulsive noise from car ignition systems and other sources. One is based on a spark plug with variable gap and controllable output. The other is a thyratron generator, providing pulses with any desired time relation to the synchronizing pulses. Calibration of these generators is considered.

621.317.7.029.64 **2726**

Integrated Microwave Test Bench.—(*Wireless World*, July 1954, Vol. 60, No. 7, pp. 351–352.) X-band test equipment comprising wavemeter, attenuator, slotted line, etc. is milled out of one solid block of light alloy instead of being assembled from separate units. Losses and undesired reflections are thus reduced.

621.317.7.029.64 **2727**

Microwave Measuring Equipment.—P. M. Ratcliffe. (*J. Brit. Instn Radio Engrs*, June 1954, Vol. 14, No. 6, pp. 243–259. Discussion, pp. 260–261.) A survey dealing with instruments for field and factory, as well as for laboratory use, at centimetre wavelengths. The measurable quantities in this band are wavelength (in preference to frequency), power (with emphasis on heating effect), and normalized impedance (in terms of electric and magnetic field). Equipment described includes capacitance-loaded-line and resonant-cavity wavemeters, thermistor-type milliwattmeter, neon-tube tester for s.w.r., directional couplers, spectrum analyser, noise generator and a complete radar test set for the 3-cm waveband.

621.317.727.029.63 **2728**

Accurate Radio-Frequency Microvoltages.—M. C. Selby (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 158–163.) Coaxial-type r.f. micropotentiometers developed at the National Bureau of Standards (1712 of 1951) are described in detail.

621.317.734.028.3 **2729**

An Instrument for Measurement of Very High Resistance.—F. J. Lynch & C. L. Wesenberg. (*Rev. sci. Instrum.*, March 1954, Vol. 25, No. 3, pp. 251–255.) An instrument for accurate measurement in the range 10^9–$10^{13}\Omega$ is described. A constant current flows through the resistor under test and potential drop is measured by an electrometer. The constant current is the displacement current flowing through a standard capacitor when the potential difference across it changes linearly with time. Provision is made for measuring resistance with 3 mV–10 V dropped across the resistor. Accuracy of the instrument is within about 0·5%.

621.317.755 : 621.3.015.3 **2730**

A Method for the Measurement of Phase and Amplitude Variations of Transient High-Frequency Phenomena.—A. Essmann. (*Z. angew. Phys.*, March 1954, Vol. 6, No. 3, pp. 115–120.) A development is described of the method of Nijenhuis (2485 of 1941) for a continuous visual presentation of phase and amplitude changes produced, e.g. by an amplifier, by means of a brightness-modulated spiral c.r.o. trace. The complete circuit, operation and application of this phase- and amplitude-analyser are given and the traces obtained with a two-stage amplifier and with a detuned single-stage amplifier are shown photographically. Phase angles can be read to within $\pm 1°$.

621.317.78.029.64 **2731**

40- to 4 000-Microwatt Power Meter.—R. W. Lange. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 492–494.) Description of an instrument for use at 10 kMc/s, comprising a temperature-compensated bolometer bridge using a bead thermistor as power detector.

621.397.62.001.4 : 535.623 **2732**

Color-Bar Generator produces I-Q Signals.—A. F. Boscia. (*Electronics*, June 1954, Vol. 27, No. 6, p. 143.) Test signals for alignment of the Q and I demodulators

for reception of N.T.S.C. colour-television signals are obtained from a colour-bar generator by control of blue-green and blue-red overlap.

621.317 2733

Electronic Measurements. [Book Review]—F. E. Terman & J. M. Pettit. Publishers: McGraw-Hill, 1952, 707 pp., 72s. 6d. (*J. atmos. terr. Phys.*, May 1954, Vol. 5, No. 2, p. 112.) The emphasis is "on the fundamental principles of measurement and of their synthesis into more elaborate techniques for specific purposes or circumstances . . . The presentation of the material is comprehensive and yet critical."

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

532.542 2734

Electromagnetic Velometry: Part 2—Elimination of the Effects of Induced Currents in Explorations of the Velocity Distribution in Axially Symmetrical Flow.—A. Kolin & F. Reiche. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, pp. 409–413.) No correction for the effects of induced currents is required if very fine unshielded wires can be used as electrodes. This is possible if the quantity measured is the potential gradient along a cross-section diameter at 45° to the direction of the magnetic field. Part 1: 3981 of 1945 (Kolin).

615.471 2735

Determination of the Resultant Dipole of the Heart from Measurements on the Body Surface.—D. Gabor & C. V. Nelson. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, pp. 413–416.) Theory was developed and verified by measurements in electrolyte tank models of the human thorax.

621.372.029.64 : 621.313.001.4 2736

Microwaves Used to Observe Commutator and Slip Ring Surfaces during Operation.—A. H. Ryan & S. D. Summers. (*Elect. Engng, N.Y.*, March 1954, Vol. 73, No. 3, pp. 251–255.) Variations in the position of a reflecting surface are used to change the effective length of the open collinear arm of a magic-T. A change of 0·5 mil can be detected by means of the apparatus described operating at a frequency of 24 kMc/s. Typical records are shown.

621.384.612 2737

Overcoming the Critical-Energy Effect in the Strong-Focusing Synchrotron.—E. Bodenstedt. (*Z. Naturf.*, Aug. 1953, Vol. 8a, No. 8, pp. 502–503.) At a critical energy value the stable equilibrium of the phase oscillation becomes unstable and the focusing action changes into a defocusing one. A theoretical estimation indicates that it is not possible to avoid the transition through this critical value. The difficulty is overcome by using a large even number of accelerating gaps grouped in two systems, and distributing the phase of the accelerating voltages so that particles are focused in passing through the gaps of the first system and defocused in passing through the gaps of the second system; when the particle energy reaches the critical value the two systems reverse.

621.384.622.1 2738

Alternating-Gradient Electrostatic Focusing for Linear Accelerators.—L. C. Teng. (*Rev. sci. Instrum.*, March 1954, Vol. 25, No. 3, pp. 264–268.) Analytical study of the application of alternate convergent and divergent lenses to a standing-wave heavy-particle linear accelerator.

621.385.833 2739

An Electron-Optical Method of Imaging Objects with Magnetic Inhomogeneities.—G. V. Spivak, N. G. Kanavina, I. N. Chernyshev & I. S. Sbitnikova. (*C. R. Acad. Sci. U.R.S.S.*, 21st Sept. 1953, Vol. 92, No. 3, pp. 541–543. In Russian.) A secondary-emission electron microscope, by means of which both the geometrical and the magnetic irregularities of the specimen can be detected, is briefly described, typical photographs are shown and the method of operation is briefly compared with the electron-optical shadow method used by Marton & Lachenbruch (1211 of 1950).

621.385.833 : 061.3 2740

Fifth Annual Convention of the German Association for Electron Microscopy, Innsbruck, 1953.—(*Optik, Stuttgart*, 1954, Vol. 11, No. 3, pp. 97–148.) The text is given of the following papers presented at the convention:—

Image Formation in the Electron Microscope (pp.101–117).—W. Glaser.

Report of French Work in the Field of Electron Microscopy during the Past Year (pp. 118–120).—R. Bernard.

Electron Microscopy at Cambridge (pp. 121–132).—V. E. Cosslett.

Electron-Microscope Investigations at the A.E.I. Research Laboratory, Aldermaston, England (pp. 133–144).—M. E. Haine.

Report of Swiss Work in the Field of Electron Microscopy (pp. 145–148).—E. W. Schütz.

621.387.424 2741

The Temperature Dependence of the Characteristics of [self-quenching] **Gas-Filled Geiger-Müller Counter Tubes.**—H. J. Mader. (*Z. Phys.*, 15th March 1954, Vol. 137, No. 2, pp. 216–227.)

621.387.424 2742

Electron Transit Times in Geiger Counters.—J. R. Heirtzler. (*Rev. sci. Instrum.*, March 1954, Vol. 25, No. 3, pp. 243–245.) Using a photoemission technique, the transit time of an electron between the cylinder and the central wire of a self-quenching Geiger counter has been measured as a function of overvoltage for different vapour fillings at different pressures. Results are presented in graphs.

621.387.424 2743

Particle Detectors of Geiger-Müller (G-M) Counter Type.—A. Benoit. (*Le Vide*, March 1954, Vol. 9, No. 50, pp. 1475–1491.) Operating principles are outlined and technological aspects discussed. 27 references.

621.398 2744

Parachute-Borne Telemetering System.—M. L. Greenough & C. C. Gordon. (*Electronics*, June 1954, Vol. 27, No. 6, pp. 148–151.) Description of a low-cost semi-expendable unit for transmitting data during the parachute descent. Seven information channels are provided, each sampled 100 times per second. The operating range is 2–10 miles. For a shorter account see *Tech. News Bull. nat. Bur. Stand.*, June 1954, Vol. 38, No. 6, pp. 81–82.

621.398 + 621.396.93] : 621.396.665 2745

Sequentially Gated Automatic Gain Control.—Eliason. (See 2677.)

PROPAGATION OF WAVES

538.566 2746

Some Stochastic Problems in Wave Propagation.—J. Feinstein. (*Trans. Inst. Radio Engrs*, Jan. & April 1954, Vol. AP-2, Nos. 1 & 2, pp. 23–30 & 63–70.) "The effect of random height variations associated with a conducting surface upon the characteristics of reflected wave energy is ascertained by the methods of physical

optics. Average received power, its variance, angular and frequency power spectra, and the field correlation pattern are determined in terms of the statistical parameters of the surface. Volume type problems are treated by ascertaining the effect of refractive index fluctuations within a slab upon an emergent wave-front, and then generalizing to a continuous medium. The results are applied to various problems encountered in tropospheric and ionospheric wave propagation."

538.566 : 535.312 **2747**

The Scattering of Electromagnetic Waves by Turbulent Atmospheric Fluctuations.—F. Villars & V. F. Weisskopf. (*Phys. Rev.*, 15th April 1954, Vol. 94, No. 2, pp. 232–240.) "The statistical theory of turbulence is applied to the problem of density fluctuations in the troposphere and the ionosphere. For suitable wavelengths, for which the so-called similarity region (Kolmogoroff spectrum) of the spectrum of turbulence is relevant, a closed formula can be given for the scattering cross section. It contains as only parameter the turbulent power dissipation S, and its angular dependence is given by $(\sin\frac{1}{2}\theta)^{13/3}$, θ being the scattering angle. The values of S required to explain ionospheric scattering are in excellent agreement with values found from investigations of meteor trails. Tropospheric data cannot be fitted with the assumptions of dry-air turbulence alone. The inference is that humidity fluctuations play an essential part in tropospheric scattering." If certain assumptions are valid, only a very small value of large-scale humidity fluctuations is required to account for the observed scattering.

621.396.11 : 551.510.535 : 523.3 **2748**

Lunar Radio Echoes and the Faraday Effect in the Ionosphere.—W. A. S. Murray & J. K. Hargreaves. (*Nature, Lond.*, 15th May 1954, Vol. 173, No. 4411, pp. 944–945.) Fading of lunar echoes has been investigated at Jodrell Bank; the frequency used was 120 Mc/s. 50 000 echoes were photographed and analysed. It is suggested that long-period fading observed during the day is due to rotation of the plane of polarization of the radio waves as they traverse the ionosphere in the presence of the earth's magnetic field; this view is supported by analysis based on the Appleton-Hartree magneto-ionic theory. Confirmation was obtained from experiments in which a vertical and a horizontal receiving dipole were alternately switched into operation.

621.396.11 : 621.317.353.2 : 551.510.535 **2749**

Effect of Nonlinearity of the Medium on Radio Waves Propagated in the Ionosphere.—I. M. Vilenski. (*C. R. Acad. Sci. U.R.S.S.*, 21st Sept. 1953, Vol. 92, No. 3, pp. 525–528. In Russian.) Assuming a square-law nonlinearity of the ionosphere, and neglecting the effect of the geomagnetic field, the field strength of the third harmonic of a monochromatic radio wave is calculated. Substitution of numerical values in the approximate formula derived indicates that the effect should be measurable for a 500-kW transmitter operating at $\omega = 10^6$. A more exact calculation is made of the effect produced by a modulated radio wave. The nonlinearity in this case causes not only a change of amplitude and phase but also a noticeable change of the depth of amplitude modulation, production of harmonics of the modulation frequency and the appearance of phase modulation which is large at low modulation frequencies and small at high ones. The expressions, which contain parameters such as the effective number of electron-molecule collisions, may be useful for determining the ionospheric parameters more simply than by the cross-modulation method.

621.396.11.029.53 : 551.510.535 **2750**

High Multiple Radio Reflections from the F_2 Layer of the Ionosphere at Brisbane.—K. Baird. (*Aust. J. Phys.*, March 1954, Vol. 7, No. 1, pp. 165–175.) Continuous night-time records of multiple F_2 reflections at normal incidence have been made at 2·28 Mc/s, and the echo patterns have been classified. Statistical analyses of occurrences of up to the 10th multiple showed that (*a*) if no account is taken of the presence or absence of E_s, the frequency of occurrence increases towards dawn, (*b*) there is no correlation between the number of reflections observed and the virtual height of the region, (*c*) there is no correlation with 'range duplications', (*d*) inverse correlation between high multiple F reflections and presence of E_s occurs only when the lower region is blanketing, and (*e*) there is no correlation between high multiples and the travelling disturbances described by Munro (2504 of 1950). High multiples show maxima at the equinoxes. Oblique incidence records indicated no reflections beyond the fifth multiple.

621.396.11.029.6 : 551.5 : 061.3 **2751**

Radio-Meteorology: Conference in Texas.—J. A. Saxton. (*Nature, Lond.*, 24th April 1954, Vol. 173, No. 4408, pp. 761–764.) Report and comment on the conference held in November 1953. Papers on tropospheric wave propagation dealt with propagation beyond the horizon, scattering by turbulent layers, measurements of atmospheric refractive index, research at 100–1 000 Mc/s by the National Bureau of Standards, prediction of propagation conditions and experiments on 8-mm waves. Other sessions were devoted to thunderstorm and tornado atmospherics, cloud and precipitation physics and weather forecasting from radar observations. See also 230 of January.

621.396.81 **2752**

The Mechanism and Distribution of Short-Period Fading under Conditions of Ionospheric Turbulence.—F. Minozuma & H. Enomoto. (*Proc. phys. Soc.*, 1st March 1954, Vol. 67, No. 411B, pp. 211–216.) "Fading phenomena are discussed in terms of the variations of optical paths produced by the turbulent ionosphere. A simple model of turbulence in the ionosphere can predict the facing speeds found in practice, and some of the physical constants involved can be deduced from the variation of field intensity with time. The technique can be applied to determine fading speed and the amplitude distributions needed for communication purposes."

621.396.812.029.62 **2753**

V.H.F. Field Intensities in the Diffraction Zone.—R. N. Ghose & W. G. Albright. (*Trans. Inst. Radio Engrs*, Jan. 1954, Vol. AP-2, No. 1, pp. 35–38.) A solution of the general wave equation is obtained assuming a refractive-index/height variation of exponential form which fits the required boundary conditions. An expression for field strength as a function of the height and the separation of transmitting and receiving aerials is derived. Calculated values of signal strength are compared with measured values.

621.396.812.3.029.62 **2754**

A Preliminary Study of Fading of 100-Mc/s F.M. Signals.—R. L. Riddle & C. R. Ammerman. (*Trans. Inst. Radio Engrs*, Jan. 1954, Vol. AP-2, No. 1, pp. 30–34.) A statistical study is made of short-period fading over a mountainous path of about 120 miles under typical midday conditions. Signal amplitudes have an essentially Rayleigh distribution; amplitude variations have a Gaussian distribution. Speed of fading and values of effective wind velocity are determined statistically; the latter are compared with measured values.

RECEPTION

621.396.621 2755

The Response of a Panoramic Receiver to C.W. and Pulse Signals.—H. W. Batten, R. A. Jorgensen, A. B. Macnee & W. W. Peterson. (*Proc. Inst. Radio Engrs*, June 1954, Vol. 42, No. 6, pp. 948–956.) A quantitative investigation is made of the dependence of output amplitude, output pulse width and apparent bandwidth of a panoramic superheterodyne receiver on signal frequency, input pulse width, actual bandwidth, sweep rate, and type of i.f. amplifier. The measured response of a receiver with single-tuned i.f. amplifier to rectangular-envelope pulses is compared with the theoretical response of a receiver with a Gaussian-shaped i.f. characteristic to Gaussian-envelope pulses. The agreement between the two cases justifies the application of the Gaussian-case analysis to most practical design problems.

621.396.621 : 621.396.812.3 2756

An Analysis of Dual Diversity Receiving Systems.—A. H. Hausman. (*Proc. Inst. Radio Engrs*, June 1954, Vol. 42, No. 6, pp. 944–947.) "A method is presented for evaluating dual diversity receiving systems by relating the characteristics of the receiving equipment to the signal levels at both receiving antennas. The characteristics of the receiving equipment are described by relating the quality of the output traffic to the input signal level. The input signal levels are in turn described in terms of the bivariate Rayleigh probability distribution function. The method is sufficiently general to enable extension to evaluate triple diversity systems and is independent of the frequency range over which diversity fading phenomena occur. The method can also be simplified to examine the over-all effectiveness of a nondiversity receiving system."

621.396.621 : 621.396.9 2757

Aircraft Receiver for VOR-ILS and Communications.—Gray. (See 2676.)

621.396.621.029.55 : 621.396.662.076.2 2758

Notes on Permeability Tuning for Short Waves.—P. Rohan. (*Proc. Instn Radio Engrs, Aust.*, May 1954, Vol. 15, No. 5, pp. 111–113.) Methods of achieving linear dial calibration are discussed. Formulae are derived for calculating the components of the resonant circuits for band changing and band spreading. Numerical examples are given.

621.396.621.54 : 621.373.424 2759

Variable-Frequency Crystal-Controlled Receivers and Generators.—T. L. Wadley. (*Trans. S. Afr. Inst. elect. Engrs*, Feb. 1954, Vol. 45, Part 2, pp. 77–90. Discussion, pp. 90–99.) The systems described are based on heterodyning the harmonic spectrum of a crystal oscillator by means of a v.f.o. and mixer so that a fixed-frequency filter can be used and interpolation between harmonics is easily effected. General principles applied to generators and receivers are discussed. Detailed consideration is given to the design of (*a*) a generator for frequencies up to 20 Mc/s derived from a 100-kc/s crystal, and (*b*) a receiver operating at frequencies up to 30 Mc/s with multiple heterodyning based on a 1-Mc/s crystal. In the latter the local oscillator is a generator of the type described and the outputs from the v.f.o. and the harmonic filter are applied respectively to the first and second mixers; a final i.f. of 456 kc/s is derived in a 2–3-Mc/s interpolation receiver. Alternative circuits are considered and performances discussed.

621.396.621.54.029.5 2760

Wide-Band Communication Receiver.—(*Wireless World*, July 1954, Vol. 60, No. 7, pp. 333–334.) A 12-valve receiver, model CAT, designed to an Admiralty specification for use in naval vessels, has a frequency range of 60 kc/s to 31 Mc/s, covered in eight switched ranges. The set is a double superheterodyne, but is switched to single-heterodyne operation on some of the ranges. The i.f. bandwidth can be adjusted over a wide range in four discrete steps.

621.396.621.59 2761

A New Method for Treating Electron Tubes when used as Superregenerative Detectors.—A. E. Mostafa & M. El-Shishini. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 207–213, 283–289 & 290–297.) Analysis is given based on treating the valve as a periodically varying element and applying the methods of superposition and successive approximation used for the solution of circuits having periodically varying resistances. Multiple resonance, the characteristic noise, the building up of oscillations to an amplitude depending on the quenching source and the valve non-linearity, and the condition for stability of super-regeneration are discussed in relation to the no-signal condition. The a.v.c. action, sensitivity, selectivity, stability and synchronization with the signal are considered. Numerical illustrations are given and experimental investigations described.

621.396.823 : 621.376.2/.3 2762

Impulse Noise in Amplitude-Modulation and Frequency-Modulation Systems.—D. Maurice. (*Onde élect.*, March 1954, Vol. 34, No. 324, pp. 303–307.) Results of a B.B.C. survey are discussed. For a f.m. system with maximum frequency swing of ± 75 kc/s and pre- and de-accentuation with 50-μs time constant, the improvement in signal/noise ratio over a comparable a.m. system with no accentuation is 26 db for both impulse noise and circuit noise above a threshold value of signal intensity. The effect of impulse noise with peak values greater than and less than carrier level on arrival at the f.m. limiter is analysed by the rotating-voltage-vector method. A family of curves based partly on calculation and partly on measurement shows how the interference from motor cars in a city street depends on the maximum frequency swing of the f.m. receiver.

STATIONS AND COMMUNICATION SYSTEMS

621.376.5 2763

Theoretical Fundamentals of Pulse Transmission: Part 1.—E. D. Sunde. (*Bell Syst. tech. J.*, May 1954, Vol. 33, No. 3, pp. 721–788.) Theory is given in a form useful both for investigating existing pulse transmission systems and for designing new ones. The relation between the pulse transmission characteristic and the frequency response characteristic is discussed, and characteristic distortion due to system imperfections is considered. Methods of evaluating pulse distortion from gain and phase deviations are presented, and the resulting limitations on pulse transmission rates in low-pass symmetrical and asymmetrical sideband systems are examined.

621.39 2764

Communications for Civil Defense.—C. A. Armstrong. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 315–326.) Discussion of the requirements for dealing with attack warning and disaster control in the U.S.A.

621.391.5 : 621.395.61 2765

The "Vagabond" Wireless Microphone System.—T. W. Phinney. (*Trans. Inst. Radio Engrs*, March/April 1954, Vol. AU-2, No. 2, pp. 44–48; *Proc. nat. Electronics Conf., Chicago*, 1953, Vol. 9, pp. 103–110.) Combined microphone and f.m. transmitter equipment for a public

address system, designed to be carried or worn, is described. The system uses inductive coupling between the transmitter and the receiver, and a carrier frequency of approximately 2·1 Mc/s. The subminiature transmitter which weighs <1 lb, is contained in a stick-type microphone housing 1¼ in. in diameter and 12 in. long. Two printed circuit plates form the main chassis, the unit, after assembly, being filled with casting resin. A microphone cartridge of special design provides the desired pre-emphasis. A ferrite-core transmitting inductor 3 in. long is used. Battery life is 40 operating hours.

621.394/.395 **2766**

Telephony and Telegraphy.—L. H. Harris. (*Proc. Instn elect. Engrs*, Part I, May 1954, Vol. 101, No. 129, pp. 83–92.) A survey covering developments in materials, components and equipment since 1946. 100 references.

621.396.1(94) **2767**

Frequency Bands allotted to Australian Radio Services as at 1/7/53.—(*Proc. Instn Radio Engrs, Aust.*, May 1954, Vol. 15, No. 5, pp. 120–121.)

621.396.44 **2768**

Program Transmission over Type-N Carrier Telephone.—R. L. Case & I. Kearney. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 791–795.)

621.396.5 **2769**

The New Jersey Turnpike — a Unique Highway Communication System.—P. F. Godley, J. R. Neubauer & D. R. Marsh. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 360–369.) Description of the radio system for this busy road, comprising seven 950-Mc/s stations forming the backbone of the system, five 150-Mc/s stations for communication with mobile units, about 75 mobile units of the police, maintenance, etc., and about 86 toll booths at 17 interchange stations.

621.396.61/.62 **2770**

Ships' Lifeboat Radio.—(*Wireless World*, July 1954, Vol. 60, No. 7, p. 308.) A transmitter-receiver approved by the British G.P.O. and Ministry of Transport has an improved kite to raise the aerial to a height of about 200 ft. Daylight ranges of over 500 miles have been obtained with radiated power of 4 W. An alternative fixed aerial is supported on an 18-ft mast. Brief details are given of the set, which transmits on 500 kc/s and 8·634 Mc/s and receives on 500 kc/s only. Power is provided by a hand-turned generator.

621.396.65.029.6 **2771**

Microwave Radio Relay Systems Symposium, New York, November 5–6, 1953.—(*Trans. Inst. Radio Engrs*, April 1954, Vol. MTT-2, No. 1, pp. 1–107; *ibid*, July 1954, Vol. CS-2, No. 2, pp. 1–107.) The text is given of the following papers presented at the symposium:—

The Microwave System of the Michigan-Wisconsin Pipeline Company (pp. 1–8).—W. P. Maginnis & H. Place.

Microwave Site Selection in Undeveloped Country (pp. 9–15).—R. D. Pynn.

Microwave Repeater Site Planning and Development (pp. 16–31).—R. D. Chapman.

Remote Control of Standby Engine Generator Sets over a Microwave System (pp. 32–35).—R. L. Halvorson.

Applications of Compandors to F.M. Radio Systems with Frequency Division Multiplexing (pp. 36–40).—M. C. Harp, M. H. Kebby & E. J. Rudisuhle.

A Double-Sideband Amplitude-Modulated Multiplex System for Use over Microwave Radio (pp. 41–49).—N. B. Tharp.

A Microwave System for Trunk Service (pp. 50–59).—J. J. Lenehan.

A Microwave Radio System for Pipeline Use (abstract only) (pp. 60–62).—E. Dyke.

Microwave and V.H.F. Radio Installation for the Union Electric System (pp. 63–83).—G. W. Fox.

Microwave Radio Relay Link for Military Use (pp. 84–88).—S. Metzger.

Transco Microwave System (pp. 89–92).—H. A. Rhodes.

Microwave Testing with Millimicrosecond Pulses (pp. 93–99).—A. C. Beck.

Theoretical Aspects of Microstrip Waveguides (abstract only) (pp. 100–102).—G. A. Deschamps.

Considerations in Klystron Design for Microwave Relay Systems (pp. 103–107).—R. W. Olthuis.

621.396.712 **2772**

The Transmitting Centre of the Institut National Belge de Radiodiffusion (I.N.R.) at Wavre-Overijse.—M. Dick. (*Brown Boveri Rev.*, Oct. 1953, Vol. 40, No. 10, pp. 370–394.) Detailed illustrated description of station layout and equipment. See also 1128 of 1953 (Hansen).

621.396.933 **2773**

The Information Content of Air-Ground Messages.—G. W. Grier, Jr. (*Trans. Inst. Radio Engrs*, March 1954, Vol. ANE-1, No. 1, pp. 5–16.) Records of air/ground communication during the landing of aircraft were analysed with a view to assessing (*a*) the general reliability of the information conveyed, and (*b*) whether the best possible use was being made of the available channel space. It is suggested that the position- and altitude-reporting functions of the pilot be taken over by a transponder.

621.396.933 **2774**

Some Channel Allocation Problems in Air-Ground Voice Communications.—W. W. Felton. (*Trans. Inst. Radio Engrs*, March 1954, Vol. ANE-1, No. 1, pp. 41–51.) Discussion based on measurements of the factors limiting the number of aircraft under simultaneous control per channel, including the maximum utilization of the channel, and the amount of communicating time per aircraft.

621.39.001.11 **2775**

Communication Theory. [Book Review]—W. Jackson (Ed.). Publishers: Butterworths Scientific Publications, London, 1953, 532 pp., 65s. (*J. atmos. terr. Phys.*, May 1954, Vol. 5, No. 2, p. 111.) "The publication of this book constitutes a very satisfactory conclusion of a symposium on 'Applications of Communication Theory', which was held at the Institution of Electrical Engineers, London in September 1952 . . . The volume now available comprises the complete text of the thirty-eight papers presented at the various sessions together with the discussions, some of which are most illuminating and considerably enhance the value of the individual contributions."

SUBSIDIARY APPARATUS

621-526 : 061.3 **2776**

Servomechanism Papers.—(*Trans. Inst. Radio Engrs*, March 1954, Vol. CT-1, No. 1, pp. 1–70.) Six papers presented at a convention held in San Francisco, August 1953, with editorial:

Trends in Feedback Systems (pp. 2–8).—O. J. M. Smith.

Nonlinear Control Systems with Random Inputs (pp. 9–18).—R. C. Booton, Jr.

A Method of Analysis and Synthesis of Closed-Loop Servo Systems containing Small Discontinuous Nonlinearities (pp. 19–34).—D. T. McRuer & R. G. Halliday.

Stability of Feedback Systems using Dual Nyquist Diagram (pp. 35–44).—P. Jones.
Optimum Lead-Controller Synthesis in Feedback-Control Systems (pp. 45–48).—L. G. Walters.
On the Comparison of Linear and Nonlinear Servomechanism Response (pp. 49–55).—T. M. Stout.
Predictor Servomechanisms (pp. 56–70).—L. M. Silva.

621.3.013.783 2777

The Use of Steel Sheet for the Construction of Shielded Rooms.—A. M. Intrator. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 599–604. Discussion, pp. 604–605.)

621.316.722.1 : 621.385.3 2778

Self-Heating Triode for Voltage Stabilization.—Hopkins. (See 2824.)

621.35 : 537.311.33 : 535.21 2779

Sun powers Telephone.—(*Electronics*, June 1954, Vol. 27, No. 6, pp. 196, 198.) Brief description of a battery comprising an array of Si strips, each about $\frac{1}{2}$ in. × 2 in., which when exposed to sunlight gives a current of 24 mA/cm² at about 0·5 V.

TELEVISION AND PHOTOTELEGRAPHY

621.397.24/.26 2780

European Television.—J. T. Dickinson. (*Wireless World*, July 1954, Vol. 60, No. 7, pp. 319–321.) Discussion of engineering problems involved in the recent international exchange experiments, in which networks operating on 405-, 625-, and 819-line standards were interconnected. The main items of the agreed performance specifications are indicated. Results were promising.

621.397.242 : 621.395.51 2781

The London-Birmingham Television-Cable System.—T. Kilvington, F. J. M. Laver & H. Stanesby. (*Proc. Instn elect. Engrs*, Part I, May 1954, Vol. 101, No. 129, pp. 117–119.) Discussion on 2625 of 1952.

621.397.26 2782

Transmission Characteristics of the Berlin-Leipzig Television Link.—G. Megla. (*NachrTech.*, March 1954, Vol. 4, No. 3, pp. 98–102.) The technical and economic considerations which led to the adoption of a radio relay network operating with a frequency of about 1·5 kMc/s are discussed, and calculations of transmitter powers required for adequate point-to-point service are given. Distances up to 82 km are covered using a 10-W f.m. transmitter with a parabolic-reflector aerial with a gain of 3·63 neper. The effect of atmospheric conditions on field strength is briefly discussed.

621.397.26 : 621.396.65.029.64 2783

Microwave Relay for Japanese Television.—T. Nomura, K. Suzuki, S. Mita & N. Sawazaki. (*Electronics*, June 1954, Vol. 27, No. 6, pp. 152–156.) Description of the seven-station, 288-mile Tokyo-Osaka relay, which operates with alternate transmitting and receiving frequencies of 4·000 and 4·045 kMc/s. The design had to take account of high free-space attenuation and deep fades. Necessary gain was provided by incorporating a 3-stage travelling-wave amplifier giving an output of about 3 W at each repeater, and by using high-gain paraboloidal aerials of diameter 13·1 ft. The repeaters are of double-heterodyne type, converting the microwave signal first to 70 Mc/s and then to 115 Mc/s.

621.397.26 : 621.396.65.029.64 2784

The Manchester-Kirk o'Shotts Television Radio-Relay System.—G. Dawson, L. L. Hall, K. G. Hodgson, R. A. Meers & J. H. H. Merriman. (*Proc. Instn elect. Engrs*, Part I, May 1954, Vol. 101, No. 129, pp. 93–109. Discussion, pp. 109–114.) The link comprises seven intermediate stations for a total path length of 247 miles, and operates in the 3·9–4·2-kMc/s band. Duplicate equipment is provided at each station, with stand-by power supply and automatic changeover facilities. All intermediate stations are unattended, a 4-wire line circuit for supervision and control linking them to the terminal points. Only two carrier frequencies are used, each repeater transmitting on one frequency in both directions and receiving on the other frequency from both directions. F.m. is used; the overall repeater bandwidth is 16 Mc/s. A travelling-wave amplifier provides the output of each repeater. Transmitter power is 1 W. Details are given of equipment and propagation tests. Outage time from all causes was <0·04% in the period June 1953–January 1954.

621.397.5 2785

Development of Television Service Standards and Application to Design of a Television Broadcast Network.—O. W. B. Reed, Jr. (*Trans. Amer. Inst. elect Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 838–850.) A discussion of frequency allocation and coverage problems in the U.S.A.

621.397.61 2786

Technical Characteristics of FTL Type No. 20-B U.H.F. Television Transmitter.—E. M. Bradburd. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 555–561.) Details are given of both sound and picture transmitters. F.m. is used for the sound transmitter and grid modulation in a wide-band amplifier for the picture transmitter. Vestigial-sideband filter and diplexer units are analysed and the construction of the cavity resonators is described.

621.397.62 2787

Television I.F. Inquiry.—G. H. Russell. (*Wireless World*, July 1954, Vol. 60, No. 7, pp. 322–325.) Review of a report prepared by the European Broadcasting Union on the basis of replies to a questionnaire, addressed to manufacturers in a number of countries, on television receiver problems. The relative importance of six major causes of interference listed varied according to local conditions; in Belgium, Denmark, Germany, Holland and the U.S.A. the most important consideration was second-channel interference, whereas in Sweden and the U.K. it was i.f. breakthrough. Oscillator radiation from nearby receivers is considered of relatively little importance. Values of i.f. in use and expected to be in use in the near future are tabulated. The different television standards used in Western Europe are summarized, and problems in the production of multistandard receivers are mentioned.

621.397.62 : 535.623 2788

Color Demodulators for Television Receivers.—E. G. Clark & C. H. Phillips. (*Electronics*, June 1954, Vol. 27, No. 6, pp. 164–166.) A circuit based on use of a split-anode heptode valve is described; this permits high-level demodulation using one valve only. Alternative cascode-connected circuits use double-triode and pentode-triode combinations.

621.397.62.001.4 : 535.623 2789

Color-Bar Generator produces I-Q Signals.—Boscia. (See 2732.)

621.397.82 2790

The Measurement of Random Monochrome Video Interference.—J. M. Barstow & H. N. Christopher. (*Trans. Amer. Inst. elect. Engrs.*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 735–741.) Two

problems are considered, (*a*) the relative importance of interference in different parts of the video spectrum, and (*b*) whether the visual mechanism sums the interference effects in various parts of the spectrum in such a way that the overall effect can be uniquely related to an overall measurement. Subjective tests are described; the results indicate that random television interference can be measured with a power meter having frequency weighting, with sufficient accuracy to be of value in the design and maintenance of television transmission circuits.

TRANSMISSION

621.396.61 2791

A Million-Watt Naval Communication Transmitter.—J. C. Walter. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 369–374.) See 821 of 1953 (Hobart).

621.396.61 : 621.373.421.13 + 621.375.2 2792

A Survey of Quality Problems in Transmitting Equipment.—H. Neck. (*Brown Boveri Rev.*, Oct. 1953, Vol. 40, No. 10, pp. 395–400.) Tolerances in a.m. transmitters are considered. The operation of a quartz-crystal oscillator for maximum stability is discussed and principles of determining amplifier distortion by intermodulation measurements are illustrated. A method of designing an a.f. amplifier based on equivalent-circuit analysis is outlined; it involves a certain mismatch of components but gives improved response at low and high frequencies at high modulation levels.

621.396.61 : 621.385-712 2793

Air Cooling of Medium- and High-Power Transmitters.—Klein. (See 2803.)

VALVES AND THERMIONICS

621.314.632 : 546.289 2794

The "Photo-Aftereffect" of Germanium Crystal Rectifiers.—M. Kikuchi & T. Onishi. (*J. phys. Soc. Japan*, Jan.–Feb. 1954, Vol. 9, No. 1, pp. 130–131.) The reduction of the rectifier resistance, as a result of illuminating the point contact for 90 sec, was observed; experiments were made to elucidate the physical processes underlying this phenomenon. The results are briefly discussed.

621.314.632 : 546.289 2795

Germanium Diodes from Spherical Pellets.—W. C. Dunlap, Jr. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, pp. 448–451.) 15-mil Ge spheres are produced within a few minutes in very large quantities by blowing molten high-purity Ge from a graphite crucible. The spherical pellets can be annealed, ground, etched, and assembled into diodes by techniques easily adaptable to mass production. The diode has a sphere-plane contact in place of the conventional whisker contact. Peak back-voltages in the range 50–100 V are easily obtained.

621.314.7 2796

A Point-Emitter/Junction-Collector Transistor.—R. H. Kingston. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, pp. 513–515.) A transistor structure using a planar *p-n* junction as a collector, and a point contact as an emitter is analysed. Theory indicates that for maximum frequency cut-off the plane containing the emitter point should be nearly parallel to the collector junction. The base resistance is a critical function of the spacing between the emitter point and the collector junction. Experimental models with modified emitter-collector configuration approaching the *p-n-p* structure give improved frequency cut-off.

621.314.7 2797

The Effect of Junction Shape and Surface Recombination on Transistor Current Gain.—A. R. Moore & J. I. Pankove. (*Proc. Inst. Radio Engrs*, June 1954, Vol. 42, No. 6, pp. 907–913.) Current gain, α, of alloy-type transistors is calculated for some particular three-dimensional geometries, using a method based on analogy with current flow in a conducting sheet, and assuming that surface recombination is the dominant factor in minority-carrier loss. The hole-flow field is plotted on a scale model. The method enables the surface recombination velocity s to be found from simple measurements; s may be useful as a criterion of surface quality. A calculation indicates that transit-time dispersion, due to unequal path lengths in transistors with nonparallel junctions, is not significant at frequencies below 1 Mc/s.

621.314.7 2798

On the Variation of Junction-Transistor Current-Amplification Factor with Emitter Current.—W. M. Webster. (*Proc. Inst. Radio Engrs*, June 1954, Vol. 42, No. 6, pp. 914–920.) The modification of the field in the base region by the injected carriers decreases the mean carrier transit time, reducing the effect of surface recombination and leading to an increase of α_{cb} as the emitter current increases. The simultaneous increase of conductivity of the base increases the rate of volume recombination and reduces emitter efficiency. The combination of the two effects gives rise to the observed decrease of α_{cb} at both high and low values of emitter current. The variation of α_{cb} with emitter current is about four times as great in *p-n-p* as in *n-p-n* type transistors.

621.314.7 2799

P-N-I-P and N-P-I-N Junction Transistor Triodes.—J. M. Early. (*Bell Syst. tech. J.*, May 1954, Vol. 33, No. 3, pp. 517–533.) A modified *p-n-p* junction transistor is described in which the *n*-type base region and the *p*-type collector region are separated by a relatively thick region of intrinsic semiconductor almost free of impurity centres. This permits establishment of a thick collector depletion layer at relatively low voltage, thus producing low collector capacitance and high collector breakdown voltage, which in turn lead to an extension of the high-frequency limit of operation and of the permissible power dissipation. Calculations based on theory indicate that oscillations at frequencies as high as 3 kMc/s may be possible. Experimental units have been produced with emitter diameter 0·01 in. and collector diameter 0·015 in., having stable gain without compensation of 20·5 db at 10 Mc/s and oscillating at frequencies up to 95 Mc/s. The *n-p-i-n* type transistor is formed by a corresponding modification of the *n-p-n* type.

621.383.27 2800

Investigations of the Dark Current of Secondary-Electron Multipliers with Cs-Sb Photocathodes.—N. Schaetti, W. Baumgartner & C. Flury. (*Helv. phys. Acta*, 15th June 1953, Vol. 26, Nos. 3/4, pp. 380–383. In German.) Continuation of investigations reported in 1518 of 1953 (Schaetti & Baumgartner). Results for Cs-Sb photocathodes are compared with those previously obtained for Li-Sb.

621.383.5 2801

Tentative Electronic Interpretation of Inertia Phenomena in Photocells.—G. Blet. (*C. R. Acad. Sci., Paris*, 26th April 1954, Vol. 238, No. 17, pp. 1704–1705.) By assuming that the conductivity of the barrier layer is proportional to the number of free electrons per unit volume, curves are derived for the potential build-up on illumination, for various illumination intensities; these

agree with experimentally obtained curves. The time constant is a characteristic intrinsic to the unilluminated barrier layer and independent of cell geometry and excitation wavelength.

621.385 **2802**

How to use Valves.—(*Elect. Times*, 18th March 1954, Vol. 125, No. 3254, p. 400.) A note summarizing the first two parts of British Standard Code of Practice C.P.1005, covering general recommendations and receiving valves, c.r. tubes and rectifiers.

621.385-712 : 621.396.61 **2803**

Air Cooling of Medium- and High-Power Transmitters.—W. Klein. (*Brown Boveri Rev.*, Oct. 1953, Vol. 40, No. 10, pp. 401–406.) An illustrated description is given of different air-cooling arrangements based on the radiator system described earlier [2933 of 1950 (Schärli)]. For a 135-kW medium-wave transmitter one low-pressure and two high-pressure blowers and an exhaust fan are used. More modern, simplified systems are shown in a 100-kW long-wave and a 25-kW medium-wave installation.

621.385.001.4 **2804**

A Comparison of 6AK5 and 5654 Tubes.—F. A. Paul. (*Trans. Inst. Radio Engrs*, March 1954, No. PGCP-1, pp. 18–32.) Vibration and shock tests are reported. Type-5654 valves, which are electrically equivalent to Type 6AK5 but are designed for increased reliability, gave very much better results, particularly in vibration tests.

621.385.004.15 **2805**

Reliability of Electron Tubes in Military Applications.—E. R. Jervis. (*Proc. Inst. Radio Engrs*, June 1954, Vol. 42, No. 6, pp. 902–906.) A statistical study was made of valves removed from military equipment as unsatisfactory. The factors leading to the removal are grouped under (*a*) maintenance and operating conditions, (*b*) environment, (*c*) application, and (*d*) inherent valve weaknesses. About one third of the valves were found not to be defective. The results indicate the importance of adequate maintenance routine. Excessively high operating temperature is the predominant cause of valve deterioration. The removal rate of the improved 'reliable' valves is only between a quarter and a third of that for the corresponding prototypes. Further improvement in respect of reliability can be achieved by applying known methods.

621.385.029.6 **2806**

Miniature Radio Valves.—V. Anisimov. (*Radio, Moscow*, March 1954, No. 3, pp. 54–56.) Graphs and tables are given of the characteristics of a new series of Russian 6·3-V subminiature valves designed for use in u.s.w. receivers. The series includes two pentodes, two triodes, a diode, a 150-V voltage stabilizer and a thyratron. The base connections are indicated on the valve label.

621.385.029.6 **2807**

Space-Charge Waves in Plasma Streams.—J. Labus & K. Pöschl. (*Arch. elekt. Übertragung*, Feb. 1954, Vol. 8, No. 2, pp. 49–54.) Extension of analysis given previously [2182 of 1953 (Labus)]. The phase velocities and phase eigenvalues are derived for the case of an electron beam in a finite magnetic focusing field.

621.385.029.6 **2808**

Application of Perturbation Theory to the Traveling Wave Tubes.—M. W. Muller & W. L. Beaver. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, pp. 542–543.) An expression is derived for the incremental propagation constant as a function of the interaction term.

621.385.029.6 **2809**

Amplification of Electromagnetic Waves due to Displacement of an Electron Beam in Crossed Electric and Magnetic Fields bounded by Resistive Walls.—O. Doehler & G. Guilbaud. (*C. R. Acad. Sci., Paris*, 3rd May 1954, Vol. 238, No. 18, pp. 1784–1786.) Small-signal analysis is presented for a particular arrangement of the general type described by Birdsall et al. (3147 of 1953). Using values of the field given by Maxwell's equations, a second-degree equation is derived for the propagation constant, the solution of which corresponds to one amplified and one attenuated wave. If one of the walls is perfectly conducting, one of these waves disappears. If the magnetic field exceeds a certain value two further waves are obtained with real propagation constants.

621.385.029.6 : 621.372.2 **2810**

Transmission-Line Analog of a Modulated Electron Beam.—S. Bloom & R. W. Peter. (*RCA Rev.*, March 1954, Vol. 15, No. 1, pp. 95–112.) The differential equations expressing wave propagation along an electron beam with laminar flow and along a lossless nonuniform transmission line are shown to be identical within certain limits. Conditions in the beam can hence be investigated by means of established transmission-line theory and by measurements on a transmission-line model of the beam. The method is illustrated by a study of space-charge-wave propagation in a planar diode, using a slotted coaxial-line model with a tapered inner conductor and making measurements of the standing-wave pattern.

621.385.029.6 : 621.372.2 **2811**

Space-Charge-Wave Amplification along an Electron Beam by Periodic Change of the Beam Impedance.—R. W. Peter, S. Bloom & J. A. Ruetz. (*RCA Rev.*, March 1954, Vol. 15, No. 1, pp. 113–120.) The common basis of various types of single-velocity space-charge-wave amplifier is established; the impedance of the beam can be changed by changing the beam voltage or diameter or the diameter of the surrounding drift tube. The transmission-line analogy developed by Bloom & Peter (2810 above) is used to determine the amplification bands of the space-charge-wave amplifier by analogy with the filter stop bands of the corresponding line.

621.385.029.6 : 621.373.423 **2812**

Analysis of the Backward-Wave Traveling-Wave Tube.—H. Heffner. (*Proc. Inst. Radio Engrs*, June 1954, Vol. 42, No. 6, pp. 930–937.) For low beam currents the valve acts as a high-gain high-Q voltage-tuned filter. As the beam current is increased, self-oscillation is produced, the frequency of which is controlled by the beam voltage to any value within the pass band. Analysis is presented for small-signal operation. See also 587 of February.

621.385.029.6.002.2 **2813**

Manufacture of a Magnetron.—(*Elect. Commun.*, March 1954, Vol. 31, No. 1, pp. 2–18.) Photographs illustrate various stages in the manufacture and testing of the Type-4J52 magnetron.

621.385.032.213.1.027.5/.6 **2814**

High-Power Industrial Vacuum Tubes having Thoriated-Tungsten Filaments.—R. B. Ayer. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 121–125.) Valves of this type (2660 of 1952) have given uninterrupted service for periods up to 22 months at anode voltages up to 17 kV.

621.385.032.216 **2815**

Negative Ion Emission from Oxide-Coated Cathodes: Part 1.—F. A. Vick & C. A. Walley. (*Proc. phys. Soc.*, 1st March 1954, Vol. 67, No. 411B, pp. 169–176.) Simple mass-spectrometer investigations are described. The predominant ions were Cl, originating mainly in the glass

envelope. A correlation between Cl ion current and cathode poisoning was established, the poisoning being appreciable when the modulator was more than 8 V positive with respect to the cathode.

621.385.032.216 **2816**

Negative Ion Emission from Oxide-Coated Cathodes: Part 2.—W. Grattidge & A. A. Shepherd. (*Proc. phys. Soc.*, 1st March 1954, Vol. 67, No. 411B, pp. 177–186.) Report on mass-spectrometer investigation of the ions emitted on activation and during cathode life. The variation of Cl ion emission with temperature and field was studied. No correlation with electron emission was found. It is probable that Cl ions are mainly responsible for ion burn in c.r. tubes.

621.385.032.216 **2817**

The Activation of Thermionic Cathodes Coated with Thoria and Zirconia.—G. Mesnard. (*J. Phys. Radium*, March 1954, Vol. 15, No. 3, pp. 151–155.) Experiments using ZrO_2 on W and Mo bases, ThO_2 on Pt and Mo bases, and complex layers give results suggesting that dissociation of the oxide may be an important cause of activation. For a more detailed account of the work see *Le Vide*, Jan. 1954, Vol. 9, No. 49, pp. 1448–1453.

621.385.032.216 **2818**

Moulded Thermionic Cathodes made of Nickel and Alkaline Earth Oxides.—G. Mesnard & R. Uzan. (*Le Vide*, March 1954, Vol. 9, No. 50, pp. 1492–1507.) The method of preparing cathodes by compressing and sintering a mixture of Ni powder and co-precipitated barium and strontium carbonates is described. Measurements on experimental valves are reported, for steady-state and for pulsed operation. The effects of current activation and heat treatment are demonstrated. The influence of sintering temperature and atmosphere and of the composition of the mixture is investigated.

621.385.032.216 **2819**

On the Electron Bombardment Effect for Deposited Barium Oxide Films.—T. Imai. (*J. phys. Soc. Japan*, Jan./Feb. 1954, Vol. 9, No. 1, pp. 28–37.) In valves with oxide cathodes, oxide films are deposited on the other electrodes by evaporation during pumping, activation and normal operation. When these films are subjected to electron bombardment, as in the case of anode and screen grid, gas is liberated, and the cathode emission decreases in consequence. The emission from the films increases or decreases on electron bombardment, according as the films are deposited at low or high cathode temperature.

621.385.032.216 : 546.431-31 + 546.431.64 **2820**

Electronmicroscopic Observation of the Change of Forms of the Coated Oxide Particles of the Oxide Cathode by the Activation.—T. Hibi. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, Dec. 1953, Vol. 5, No. 6, pp. 573–580.) Results indicate that the degree of activity of oxide particles is related to structural changes occurring at various depths from the surface, as shown in 16 photographs. The changes in barium carbonate particles are also shown photographically and are briefly discussed.

621.385.15 **2821**

Potential Distribution and Prevention of a Space-Charge-Induced Minimum between a Plane Secondary Electron Emitter and Parallel Control Grid.—G. C. Sponsler. (*J. appl. Phys.*, March 1954, Vol. 25, No. 3, pp. 282–287.) The critical electrode spacing required to avoid formation of a minimum is derived from a potential-distribution analysis.

621.385.15 + 621.385.832 : 621.3.018.75 **2822**

Some Experiments on Beam-Deflection Devices and Electron Multipliers for Millimicrosecond Pulses.—C. H. Vincent. (*Onde élect.*, Feb. 1954, Vol. 34, No. 323, pp. 119–122.) "An experimental tube with two fast deflector systems has been built and used to indicate coincidences between pulses in coaxial lines with millimicrosecond accuracy. Another tube incorporating an electron multiplier is being constructed as a possible means of amplifying millimicrosecond pulses and for the purpose of studying the characteristics of electron multipliers when delivering large current pulses of millimicrosecond duration."

621.385.15.032.23 **2823**

Methods of Processing Silver-Magnesium Secondary Emitters for Electron Tubes.—P. Rappaport. (*J. appl. Phys.*, March 1954, Vol. 25, No. 3, pp. 288–292.) Processing experiments under controlled conditions involving various atmospheres, baking times and temperatures were carried out. To produce the best emitter, in which subsequent evaporation of Mg after overheating was almost eliminated, the Ag-Mg alloy was baked first in a low-pressure water-vapour atmosphere for 30 minutes at 550°C, then at standard pressure in an oxygen atmosphere for 5 minutes at 700°C.

621.385.3 : 621.316.722.1 **2824**

Self-Heating Triode for Voltage Stabilization.—E. G. Hopkins. (*Wireless Engr*, July 1954, Vol. 31, No. 7, pp. 169–171.) The valve described has two planar oxide cathodes with a planar grid between them, and two auxiliary anodes which clamp the grid circuit alternately to the two cathodes. A circuit is shown in which the valve is connected between an a.c. supply and a small fixed load, and acts as a stabilizing variable resistance.

621.385.3 / .4 .001.4 : 621.396.822.029.45 **2825**

Oscillographic Measurements of Valve Noise in Audio-Frequency Channels.—G. V. Subhadramma. (*Indian J. Phys.*, July 1953, Vol. 27, No. 7, pp. 359–367.) Measurements made on one tetrode and several triode valves over the frequency range 375–1 320 c/s are reported. For a given frequency channel, the triode curves for noise/filament-current exhibit a maximum, in some cases followed by a minimum, for a given anode voltage, while the tetrode curve exhibits a saturation effect. The position of the maximum is the same for all frequencies, but the height of the maximum increases with frequency. For given filament current the amount of noise varies inversely as anode voltage. The absolute values of equivalent noise voltage range from about 20 to 200 μV.

621.385.3.029.62 **2826**

V.H.F. High-Power Transmitting Tubes.—R. Hübner. (*Brown Boveri Rev.*, Oct. 1953, Vol. 40, No. 10, pp. 417–421.) Description of the construction of BTL-type triodes with thoriated tungsten cathodes and air cooling.

621.385.832 : 681.142 **2827**

An Electron-Beam Tube for Analog Multiplication.—Angelo. (See 2583.)

621.387 : 621.375.2.024 **2828**

Transient Response of Glow Discharges with Applications.—R. S. Mackay & H. D. Morris. (*Proc. Inst. Radio Engrs*, June 1954, Vol. 42, No. 6, pp. 961–964.) Experiments were made with neon and argon lamps, the discharge being maintained by a fixed voltage with a signal voltage superimposed; the voltage variation across a series resistance was observed oscillographically. Transient responses consistent with observed frequency responses were obtained, the response time and characteristic overshoot corresponding to an inductance approaching 1 H. Application of standard neon lamps as level-changing coupling elements in direct-coupled amplifiers is indicated.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.232 **2829**

Determination of Equivalent-Circuit Constants of Piezoelectric Resonators of Moderately Low Q by Absolute-Admittance Measurements.—G. E. Martin. (*J. acoust. Soc. Amer.*, May 1954, Vol. 26, No. 3, pp. 413–420.) Previously established analysis [3164 of 1953 (Cady)] is extended to apply to the conditions governing underwater sound transducers or $BaTiO_3$ resonators in air. The errors inherent in the derived formulae are evaluated by exact numerical calculations; they are very much smaller than those resulting with the conventional method of calculation.

534.232 **2830**

The Electro-Acoustic Sensitivity of Cylindrical Ceramic Tubes.—R. A. Langevin. (*J. acoust. Soc. Amer.*, May 1954, Vol. 26, No. 3, pp. 421–427.) An exact formula is derived for the sensitivity of cylindrical $BaTiO_3$ transducers for underwater use, for various boundary and polarization conditions.

534.26 + [538.566 : 535.42 **2831**

Diffraction by Two Parallel Planes of Finite Length.—Williams. (See 2908.)

534.321 : 534.75 **2832**

Subjective Musical Pitch.—W. D. Ward. (*J. acoust. Soc. Amer.*, May 1954, Vol. 26, No. 3, pp. 369–380.) A distinction is drawn between pitch and frequency analogous to that between loudness and intensity. Experiments are described which demonstrate the validity of the subjective measure 'octave' for determining scales for pure tones presented successively. Day-to-day variations of judgments are ascribed to a binaural effect.

534.321.9 **2833**

Ultrasonic Spectrum of Cavitation Noise in Water.—R. H. Mellen. (*J. acoust. Soc. Amer.*, May 1954, Vol. 26, No. 3, pp. 356–360.) An investigation of the noise spectrum produced by transient cavities of the type encountered in tip cavitation of marine propellers. Measurements over the frequency range 1–3 500 kc/s are reported.

534.321.9 : 534.613 **2834**

Radiation Pressure and the Nonisotropic Nature of Acoustic Pressure at High Intensity.—V. Gavreau & M. Miane. (*C. R. Acad. Sci., Paris*, 31st May 1954, Vol. 238, No. 22, pp. 2148–2150.) Using a plane wave of frequency 77·1 kc/s, particle velocity and sound intensity were determined from measurements of the amplitude of vibration of the generator. Radiation pressure was measured with a sensitive balance, using conical obstacles with the apex directed towards the source, and was found to vary as the square of the cosine of the cone base angle. Cones with various types of surface, e.g., smooth, absorbent, stepped, perforated, were used. The results indicate that for intense radiation the pressure is greatest in the direction of propagation; the effect may be accompanied by an increase in the velocity of propagation.

534.6 **2835**

Standard Test Gear developed by the Acoustics Department of C.N.E.T.—P. Chavasse & P. Riéty. (*Ann. Télécommun.*, March & April 1954, Vol. 9, Nos. 3 & 4, pp. 58–71 & 94–98.) Tests are carried out by the Department on (*a*) electroacoustic transducers, (*b*) acousto-electric transducers, (*c*) acoustic networks, e.g., hearing aids and acoustic transmission systems, (*d*) a.f. amplifiers and oscillators, (*e*) sound sources. The equipment developed for test purposes is briefly described, but details are given of a special c.r.o. deflection circuit and of the synchronization of the frequency-sweep oscillator and the recording gear. Equipment for work in physiological acoustics is also provided.

534.6 **2836**

Determination of Absolute Sound Levels and Acoustic Absorption Coefficients by Thermocouple Probes.—W. J. Fry & R. B. Fry. (*J. acoust. Soc. Amer.*, May 1954, Vol. 26, No. 3, pp. 294–317.) Theoretical and experimental aspects of the method are discussed. The sound intensity is determined from the specific heat and the absorption coefficient of the material in which the thermocouple is embedded and the observed rate of change of temperature at the thermocouple junction on application of a sound pulse.

534.75 **2837**

Responding to One of Two Simultaneous Messages.—W. Spieth, J. F. Curtis & J. C. Webster. (*J. acoust. Soc. Amer.*, May 1954, Vol. 26, No. 3, pp. 391–396.) The effect of the following factors on the ability of an operator (e.g., an air-control-tower operator) to attend to one of two simultaneous messages was investigated: (*a*) horizontal separation between message sources, (*b*) cue lamps, (*c*) a 'pull-down' arrangement for switching a chosen message from the originating loudspeaker into one near his left ear, (*d*) use of different a.f. filters in the different channels. Suitable adjustment of factors (*a*) and (*d*) improved the operator's performance greatly.

534.75 **2838**

Responding to Both of Two Overlapping Messages.—J. C. Webster & P. O. Thompson. (*J. acoust. Soc. Amer.*, May 1954, Vol. 26, No. 3, pp. 396–402.) Experiments are described which show that the ability of an operator to respond to overlapping messages decreases as the overlap time increases. The leading message is understood better unless its intensity is considerably lower. An examination is made of factors in the messages affecting ease of differentiation.

534.78 **2839**

On the Identification of Speakers by Voice.—I. Pollack, J. M. Pickett & W. H. Sumby. (*J. acoust. Soc. Amer.*, May 1954, Vol. 26, No. 3, pp. 403–406.)

534.78 **2840**

Design of Visible Speech Devices.—G. E. Peterson. (*J. acoust. Soc. Amer.*, May 1954, Vol. 26, No. 3, pp. 406–413.)

534.79 **2841**

Loudness Relations in Two-Component Tones.—A. M. Small, Jr, & W. R. Thurlow. (*J. acoust. Soc. Amer.*, May 1954, Vol. 26, No. 3, pp. 381–388.) Experiments were conducted to determine how the loudness of each component of a two-tone stimulus changes as the intensity of the higher-frequency component is raised from masked threshold to well above that level. Results are shown graphically for various pairs of frequencies. Opposite loudness-variation effects were observed for higher-frequency components above and below 1 kc/s respectively.

534.833 **2842**

Sound Insulation with Light-Weight Structures.—J. Pujolle & R. Lamoral. (*Onde élect.*, April 1954, Vol. 34, No. 325, pp. 384–386.) Measurements are reported on structures of weights up to 15 kg/m², suitable for movable partitions or sound-proof doors. With complex structures based on duralumin and compressed wood, results appreciably better than indicated by the mass law were obtained. A new method of fixing, using a multicellular plastic, gave good insulation and damped out low-frequency vibrations.

534.833.4 **2843**

Sound Absorption by Perforated Porous Tiles: Part 1.—U. Ingard. (*J. acoust. Soc. Amer.*, May 1954, Vol. 26, No. 3, pp. 289–293.) Formulae are derived from which the acoustic properties of the tile can be calculated in terms of its geometry and the physical properties of the material. Measurements of the normal impedance as a function of perforation depth are in good agreement with calculated values.

534.845 **2844**

Acoustic Factors in the Design of Noise-Reducing Telephone Booths.—D. E. Bishop, F. G. Hewitt & D. B. Callaway. (*J. acoust. Soc. Amer.*, May 1954, Vol. 26, No. 3, pp. 318–322.) Investigations are described resulting in a triangular design for a doorless booth.

621.395.625.3 **2845**

Avoiding Echo Phenomena in Multiple-Track Magnetic Recording Systems.—G. Ouvrier. (*Funk u. Ton*, April 1954, Vol. 8, No. 4, pp. 174–178.) Results of experiments show that crosstalk between neighbouring sound tracks originates in the reproduction and not during recording. The dependence of the effect on recorded frequency, running speed and track spacing is considered.

621.395.625.3 : 538.221 **2846**

Ferrites as Core Materials for Magnetic Recording Heads.—O. Schmidbauer. (*Funk u. Ton*, April 1954, Vol. 8, No. 4, pp. 169–173.) An expression is derived for the useful induced flux, taking account of the 'magnetic roughness' of the ferrite surface due to the coarse granular structure. Roughness values for different ferrites are determined by comparison with a mumetal head. Ferrite heads should be suitable where medium and high tape speeds are used, and in conjunction with magnetic films.

621.395.625.3 : 621.397.5 **2847**

Recording Television and Sound Signals on Magnetic Tape.—(*Electronic Engng*, July 1954, Vol. 26, No. 317, pp. 292–295.) See 2517 of August (Olson et al.).

621.395.625.6 : 778.534.4 **2848**

A Photographic Technique of Sound Recording on Glass Discs.—A. J. Forty. (*P.O. elect. Engrs' J.*, April 1954, Vol. 47, Part 1, pp. 19–24.) A description of the process used by the British Post Office, with discussion of factors limiting performance. The main application is in announcing machines for the telephone service.

AERIALS AND TRANSMISSION LINES

621.372.2 + 621.317.34.029.64 **2849**

An Experimental Investigation of the Single-Wire Transmission Line.—T. E. Roberts, Jr. (*Trans. Inst. Radio Engrs*, April 1954, Vol. AP-2, No. 2, pp. 46–56.) The lines investigated were dielectric-coated wires of brass and hard-drawn copper of length about 80λ. Measurements were made at λ 3·2 cm to determine (*a*) charge and current distributions, (*b*) attenuation and phase velocity, and (*c*) the radiation conductance applicable in the equivalent circuit for the transition from a flanged coaxial line to a single-wire line. Measurement techniques are described. Results verify the theoretical result that the single-wire line, if sufficiently long, may be treated as a simple transmission line (1580 of 1953). Comparison with data for uncoated wires clearly shows the guiding properties of a thin dielectric coating. The efficiency of horn couplings used in the measurements was also determined experimentally.

621.372.2 + 621.372.8 **2850**

Use of Short-Circuiting Pistons in the Study of Junctions and Directional Couplers.—A. Weissfloch. (*Ann. Télécommun.*, March 1954, Vol. 9, No. 3, pp. 81–92.) Line junctions are treated as six- or eight-pole networks, according as they are of T or X type. For junctions for particular applications, a method of measurement using nonreflecting terminations is often satisfactory. For six-pole junctions for general use a more accurate method is described in which the output lines are terminated by short-circuiting pistons and the only measurement required is the position of the voltage nodes on the input line. Proof of the theory of the method and notes on experimental technique and the accuracy attainable are

presented. The application of the method to junctions of eight-terminal type and to directional couplers is also explained.

621.372.2 **2851**

Waves of Current without Voltage and of Voltage without Current in Two Parallel Lines.—M. Cotte. (*Onde élect.*, April 1954, Vol. 34, No. 325, pp. 381–383.) Analysis based on Laplace transforms is given. See also 3776 of 1947, where analysis is based on Carson transforms.

621.372.2 : 621.315.212 **2852**

Application of Brewster's Angle to the Design of Coaxial-Line Components for Microwaves.—B. A. Dahlman. (*RCA Rev.*, June 1954, Vol. 15, No. 2, pp. 238–251.) A theoretical investigation is made of the conditions under which refraction without reflection can be obtained at the boundary between two dielectrics, with particular reference to the use of conical lines as adapters between coaxial cylindrical systems. The observed v.s.w.r. for an experimental system using such an adapter between two 50-Ω lines of overall diameter $\frac{7}{8}$ in. and $\frac{3}{8}$ in. respectively was $< 1{\cdot}06$ over the frequency range 2–5·8 kMc/s.

621.372.8 + 621.396.677.7 **2853**

On the Theory of Corrugated Plane Surfaces.—R. S. Elliott. (*Trans. Inst. Radio Engrs*, April 1954, Vol. AP-2, No. 2, pp. 71–81.) Analysis is based on applying Floquet's theorem to Lucke's resonator principle for determination of the propagation characteristics of a corrugated surface. If the non-corrugated side and top walls of a waveguide with corrugated bottom wall are gradually flared out and terminated, a surface wave can be satisfactorily launched on the extended bottom wall; if at the other end the depth of corrugations gradually decreases to zero, a good match to a rectangular waveguide may be achieved, the system operating efficiently with TE_{01}-mode excitation. Approximate radiation patterns are derived for such a system terminated by (*a*) an infinite, and (*b*) a finite, ground plane. For the latter case approximate theory gives an upper limit for the tilt angle of the main beam and a lower limit for beam width. The suppression of feed radiation and the elimination of higher-order modes are considered. Experimental data fit the theory reasonably well.

621.372.8 **2854**

Circumferential Gap in a Circular Waveguide Excited by a Dominant Circular-Electric Wave.—L. S. Sheingold & J. E. Storer. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, pp. 545–552.) The gap is considered as a free space coupling two semi-infinite waveguides, the width of the gap being small compared with the guide wavelength. The effect of the gap on the propagation of the TE_{01} mode is examined, the scattering matrix being derived by a variational method. Results of measurements on a brass waveguide of internal diameter 5·755 in., at a free-space wavelength of 10 cm, support the theory.

621.372.8 **2855**

Propagation of Microwaves through a Cylindrical Metallic Guide Filled Coaxially with Two Different Dielectrics: Part 5.—S. K. Chatterjee. (*J. Indian Inst. Sci.*, Section B, April 1954, Vol. 36, No. 2, pp. 48–58.) General conditional equations are formulated from which the propagation characteristics of any hybrid mode can be derived using the theory presented in part 4 (1992 of July). Calculations are made for the special case of a simple dielectric rod. This behaves as a guide or as an aerial according as its radius is under or over a critical value depending on the mode of excitation.

621.372.8 **2856**

Attenuation Coefficient of Waveguides loaded with Circular Irises.—R. Combe. (*C. R. Acad. Sci., Paris*, 24th May 1954, Vol. 238, No. 21, pp. 2063–2065.) An approximate expression is obtained for the attenuation of a rotationally symmetrical mode with a longitudinal electric field component in a loaded circular waveguide. The formulae obtained are useful for the design of electron accelerators.

621.372.8 : 621.385.029.64 **2857**

Broadbanding of Resonant-Type Microwave Output Windows.—T. S. Chen. (*RCA Rev.*, June 1954, Vol. 15, No. 2, pp. 204–229.) The bandwidth of magnetron output windows of the type described previously (2307 of August) is increased by placing a resonant iris at a distance of $\lambda/4$ on each side of the ceramic plate. Bandwidths of 1·0 and 1·57 kMc/s centred at 9·15 and 9·35 kMc/s respectively have been obtained for two different ceramics. The v.s.w.r. was $< 1{\cdot}1$ in both cases.

621.396.67 **2858**

Skeleton Slot Aerial.—H. B. Dent. (*Wireless World*, Aug. 1954, Vol. 60, No. 8, pp. 399–401.) An aerial which has operated satisfactorily on the 2-m amateur band has the form of a rectangular metal frame of length slightly less than $\lambda/2$ and width about a third of the length. When erected with the long side vertical, its radiation is horizontally polarized, and it has a useful power gain over a simple horizontal $\lambda/2$ dipole. Methods of combining with a reflector are discussed. Measured polar diagrams are shown.

621.396.67 **2859**

The Theory and Application of the Radiation Mutual-Coupling Factor.—E. A. Blasi. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1179–1183.) A formula is derived for the mutual impedance of two radiating elements in terms of the self-impedances. A convenient new parameter, the radiation mutual-coupling factor, is defined which can be accurately measured. The technique is illustrated for the case of (*a*) a pair of identical $\lambda/4$ aerials, and (*b*) a pair of identical axial-mode helical radiators. Experimental results support the theory.

621.396.673 **2860**

Impedance of a Top-Loaded Antenna of Arbitrary Length over a Circular Grounded Screen.—J. R. Wait & W. J. Surtees. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, pp. 553–555.) Abbott's method (2729 of 1952) is used to calculate the approximate self-impedance of a thin top-loaded vertical aerial over a infinitely conducting screen lying on a finitely conducting ground.

621.396.677 : 621.396.721.029.51/.53 **2861**

The Problem of the Long-Wave Radio Relay.—R. Kümmich. (See 3042.)

621.396.677.7 **2862**

On the Bandwidth of Cavity Antennas.—M. H. Cohen. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, pp. 582–587.) To simplify calculation, a cavity is considered which comprises a shorted square waveguide, of side *a*, opening into a half-space; the resonance frequency and the bandwidth ($1/Q$) are determined from transmission-line theory. The analysis depends on an equivalent aperture admittance. The minimum value of Q for such an aerial is given by $0{\cdot}424\ (a/\lambda)^{-3}$ for values of $(a/\lambda) < 0{\cdot}35$. The cavity depth required to obtain minimum Q is of the order of $4a$. The required dielectric constant increases rapidly as a/λ decreases. Experimental results which support the theory are presented.

621.396.677.7 **2863**

Theory of Thin Aerials in Endovibrators.—A. V. Gaponov & M. L. Levin. (*C. R. Acad. Sci. U.R.S.S.*,

21st April 1954, Vol. 95, No. 6, pp. 1193–1196. In Russian.) A method is developed of solving the problem of excitation by currents flowing in the perfectly conducting walls of an endovibrator with thin aerials, slots, or both. The problem of excitation at the resonance frequency has been considered by Fel'd in his book 'Foundations of the Theory of Slot Aerials' (in Russian), Moscow, 1948.

621.396.677.8 **2864**

Propagation of Microwaves between a Parallel Pair of Doubly Curved Conducting Surfaces.—K. S. Kunz. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, pp. 642–653.) Mathematical theory is given for microwave lenses comprising parallel plates with the intervening space filled with a substance of arbitrary refractive index. The spacing between the plates is assumed small compared to λ; only the TEM mode is then propagated. A family of equivalent lenses is shown to exist; the conditions are determined for one member of the family to have unity refractive index everywhere. It is shown that the Rinehart analogue of the Luneberg lens and the R.C.A. 'R-2R' lens are members of a family with analogous focusing properties.

621.396.677.83 **2865**

Wide-Band Aerials with High Gain Efficiency.—H. Meinke. (*Fernmeldetech. Z.*, April 1954, Vol. 7, No. 4, pp. 161–170.) Aerials for the frequency range 200 Mc/s–2 kMc/s, using parabolic-cylinder reflectors with conducting ends, are discussed in relation to the requirements of high gain in the main radiation direction, low side lobes, and satisfactory wide-band matching. It is shown that when the dimensions of the reflector are not greater than a few wavelengths, efficiencies of over 100% can be attained in theory and of nearly 100% in practice. Radiation pattern and matching are discussed in relation to problems of construction. The reflector may be combined with a horn.

621.396.677.831 **2866**

An Analysis of Passive Reflector Antenna Systems.—R. E. Greenquist & A. J. Orlando. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1173–1178.) Equivalent-aperture theory is used to derive the gain and radiation pattern for a system with a plane rectangular reflector at 45° to the aerial beam. Experimental results support the method of analysis. Side-lobe levels and mutual coupling are also discussed.

621.396.677.833.1 **2867**

Field Problem for a Parabolic Reflector.—G. A. Grinberg, N. N. Lebedev, I. P. Skal'skaya & Ya. S. Uflyand. (*C. R. Acad. Sci. U.R.S.S.*, 11th April 1954, Vol. 95, No. 5, pp. 961–963. In Russian.) The field due to a linear aerial placed along the focal line of a parabolic cylindrical reflector is considered. The solution of the equation $\Delta u + k^2 u = 0$, where u is the complex amplitude of the electric field, is given as the sum of two terms, the first involving the Hankel function of the second kind of kr, where k is the wave number and r the distance, the second involving a definite integral of hypergeometric functions of a parameter ν. For $|\alpha| < \beta$, where α and β are the parabolic coordinates, the integral can be evaluated in the form of an infinite series. Magnus's solution (1966 of 1942) is discussed and found to be valid in this region and hence, from the properties of elliptic integrals, in the whole region where u is a regular function.

AUTOMATIC COMPUTERS

681.142 **2868**

A Versatile Electronic Function Generator.—R. Tomovich. (*J. Franklin Inst.*, Feb. 1954, Vol. 257, No. 2, pp. 109–120.) Two types of electronic circuit for performing any desired transformation on two arbitrary voltage waveforms are described. The general characteristics and accuracy of such devices when used in repetitive differential analysers are discussed.

CIRCUITS AND CIRCUIT ELEMENTS

621.318.57 : 621.314.7 **2869**

Transistor Shift Registers.—R. H. Baker, I. L. Lebow & R. E. McMahon. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1152–1159.) "Three different types of high-speed transistor shift registers are discussed. The high speed (3 to 5μs per shift pulse) is made possible by the use of nonsaturating bistable circuits. Two general shift registers are described making use of respectively one and two transistors per stage. The third register is of a specialized variety capable of shifting a single digit. In addition, an analysis is made of the triggering requirements of the register using a single transistor per stage."

621.318.57 : 621.372.8 **2870**

Waveguide Switching Device using Gas-Filled Tubes.—L. Tourel, P. Tcheditch, M. Lamy & P. Vincent. (*Ann. Radioélect.*, April 1954, Vol. 9, No. 36, pp. 163–179.) An arrangement for switching a single receiver between two or more channels at a relatively high rate is described. The switching operation is based on detuning an oscillatory circuit consisting of a waveguide section terminated with inductive diaphragms and having a gas-discharge tube located midway between the ends; the h.f. susceptance of the tube varies with its ionization state, and the tube constitutes an element of a band-pass filter. Analysis is given for the pass band, the switching rate, the electrical inertia and the noise and insertion loss due to the device. Results obtained with a four-channel system are in good agreement with theory.

621.319.42 **2871**

Component Design Trends — Fixed Capacitors undergo Miniaturization.—F. Rockett. (*Electronics*, July 1954, Vol. 27, No. 7, pp. 120–125.) First paper of a series describing recent developments. Problems involved in operating at the high temperatures resulting from reduction of the heat-dissipating surface are discussed.

621.372 **2872**

Some Techniques for Network Synthesis.—G. L. Matthaei. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1126–1137.) The synthesis of immittances with two poles and two zeros is discussed; Cauer's continued-fraction technique is generalized for use in realizing *RLC* network immittances. Design procedure is developed for a constant-resistance ladder; this network is shown to have the same field of application as the conventional *RLC* constant-resistance bridged T, but has the advantages of greater flexibility and less complexity. Complicated transfer functions may be realized in a chain of ladder sections having arm immittances with only two poles and two zeros.

621.372 : 517.432 **2873**

Analysis of Network Response to Periodic Waves.—P. M. Seal. (*J. Franklin Inst.*, Jan. 1954, Vol. 257, No. 1, pp. 13–24.) The steady-state response of a network to a nonsinusoidal periodic wave may be found by applying the operational-calculus method of Waidelich (1276 of 1946) in a simplified form. The method can be used for any linear network comprising a finite number of lumped elements. A set of rules for obtaining the required inverse transforms together with a table of inverse transforms for square-wave inputs is presented and explained.

621.372 : 621.314.7 2874

Feedback in Junction Transistor Circuits.—D. W. Gade. (*Electronics*, July 1954, Vol. 27, No. 7, pp. 174–176, 178.) "Series and parallel feedback circuits for a single stage are reduced to a four-parameter equivalent circuit for analysis. Cascaded transistor stages reduced in a similar manner result in either mesh or nodal-derived equivalent circuits."

621.372.011 2875

***Q* as a Mathematical Parameter.**—D. Morris. (*Electronic Engng*, July 1954, Vol. 26, No. 317, pp. 306–307.) A definition applicable to *RC* networks and other systems having lumped parameters, and appropriate in cases where the Q value is of the order of $\frac{1}{2}$ or less, gives Q in terms of circuit time constant and the differential operator.

621.372.029.3(083.7) 2876

I.R.E. Standards on Audio Techniques: Definitions of Terms, 1954.—(*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1109–1112.) Standard 54 I.R.E. 3 S1.

621.372.41 : 621.396.822 2877

Thermodynamical Consideration of Equilibrium Electrical Fluctuations.—M. L. Levin. (*Uspekhi fiz. Nauk*, March 1954, Vol. 52, No. 3, pp. 486–494.) Expressions are derived for the mean energy of electrical fluctuations in an *LCR* circuit maintained at a given temperature and for the spectral density of the fluctuation e.m.f. Similar expressions published earlier by Gorelik and Ginzburg are discussed.

621.372.5 : 512.83 2878

Two Network Theorems concerning Change of Voltage Reference Terminal.—J. Shekel. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, p. 1125.) "The first theorem describes the change in the admittance matrix corresponding to the change of the voltage reference terminal ('ground' terminal). The second thoerem shows that the determinant of the admittance matrix is invariant under such transformations."

621.372.5 : 621.316.89 : 537.311.33 2879

The Application of Some Semiconductors as Logarithmic Elements.—N. M. Schaeffer & G. W. Wood. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1113–1116.) Voltage dividers incorporating Cu_2O rectifiers to give special characteristics were described by Kallmann (3554 of 1946). For circuits involving high resistances, rectifiers made from other semiconductors may be more suitable. Logarithmic characteristics obtained using various semiconductor rectifiers are presented. Temperature compensation is achieved by use of negative-temperature-coefficient resistors. The logarithmic response has been obtained at frequencies up to 100 kc/s.

621.372.54 2880

Practical Low-Pass and Band-Pass Minimum-Phase Networks with Equalized Delay and Aperiodic Transient Response.—H. H. Voss. (*Frequenz*, April 1954, Vol. 8, No. 4, pp. 97–102.) A minimum-phase-shift network with constant delay characteristic is a practical approximation to an idealized low-pass filter, since its attenuation characteristic in the pass band has a similar shape. Conditions for delay equalization are investigated for a unit-step input, in terms of the positions of the zeros and poles of the response function. A general method of calculation for filter networks of this type is given. The attenuation and group-delay characteristics in a simple case are compared with those of an equivalent filter based on image-parameter theory.

621.372.54 2881

Audio-Frequency Filter with Continuously Adjustable Attenuation Characteristic.—A. Spälti. (*Tech. Mitt. schweiz. Telegr.-Teleph Verw.*, 1st April 1954, Vol. 32, No. 4, pp. 121–125.) A composite filter for the frequency band 85 c/s–7 kc/s is described, comprising two sets each of 24 separately controllable filters with contiguous narrow frequency bands. The controls are arranged so that the positions of the individual knobs give an approximate representation of the overall frequency characteristic. The device is useful for investigating correcting networks and for producing special effects in broadcasting.

621.372.54 2882

Synthesis of Constant-Time-Delay Networks.—M. S. Corrington & R. W. Sonnenfeldt. (*RCA Rev.*, June 1954, Vol. 15, No. 2, pp. 163–186; *Proc. nat. Electronics Conf., Chicago*, 1953, Vol. 9, pp. 50–63.) The synthesis of low-pass filters to have a symmetrical transient response such as is desirable in television receivers is investigated. The desired frequency response is expanded in a Fourier series; circuit elements corresponding to the terms of the series are constituted by sections of delay lines, which are appropriately combined to give the desired overall response. Low-pass, band-pass and band-stop filters are considered. Results obtained with experimental filters are discussed.

621.372.54 : 681.142 2883

Punched-Card Calculating Machines as Aids in the Calculation of Filters.—W. Heimann. (*Arch. elekt. Übertragung*, April 1954, Vol. 8, No. 4, pp. 173–178.) The use of commercial-type punched-card calculators for solving numerical problems involved in insertion-loss filter theory is discussed and illustrated.

621.372.544.2 2884

Comb Filters for Pulsed Radar Use.—S. F. George & A. S. Zamanakos. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1159–1165.) The use of comb filters for improving signal/noise ratio is discussed in relation to the variation of the frequency spectrum of a radar signal with the number of pulses in the received trains. The relative merits of (*a*) the simple uniform type, (*b*) the rectangular $(\sin x/x)^2$ type, and (*c*) the North type $(\sin x/x)^2$ matched filters are compared. The small gain in sensitivity obtained with type (*c*) does not warrant the greater complexity of its design.

621.372.632 + 621.375.23 2885

Gain Stable Mixers and Amplifiers with Current Feedback.—G. E. Boggs. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1144–1147.) "Narrow-band radio-frequency amplifiers and mixers may be stabilized by negative feedback without increasing the bandwidth excessively. A couple using current feedback is described. This couple requires only a simple resistive beta circuit and may be designed such that the band-pass characteristic is largely independent of the feedback." Experimental results are reported.

621.373 2886

van der Pol's Equation.—Z. Akcasu. (*Wireless Engr*, Aug. 1954, Vol. 31, No. 8, pp. 198–203.) An analytic method of solving the equation $x'' + x = \mu f(x)x'$ is described in which the unknown functions a and θ of the assumed solution $x = a\sin(t + \theta)$ are found by substituting the assumed solution into the integro-differential form of the original equation. The solution of the first approximation thus obtained is identical with solutions previously obtained by others. In the second approximation the method yields the interdependence between amplitude and instantaneous frequency during the

transient period. The effect of the harmonic content is calculated. The theory is applied to the case of a valve oscillator with tuned anode circuit.

621.373 : 621.387 2887

The Ionic Oscillator.—T. E. Fairbairn. (*Radio-Electronics*, Dec. 1953, Vol. 24, No. 12, pp. 76..80.) A stable device capable of delivering high output at a.f. or r.f. comprises a simple gas-filled-valve circuit without external or internal resonators. Anode voltage equal to the normal ionization voltage is applied. A.m. and f.m. arrangements are indicated. The upper frequency limit is $> 1{\cdot}5$ Mc/s.

621.373.4 2888

A Reactance Tube Controlled Oscillator of Unusually Wide Frequency Sweep.—B. M. Banerjee. (*Indian J. Phys.*, Feb. 1954, Vol. 28, No. 2, pp. 67–74.) Circuits permitting frequency sweeps up to 16 Mc/s are described, one for operation above and the other below 30 Mc/s.

621.373.42 2889

Quartz Generators with Negative Feedback and an Inertial Nonlinearity.—M. E. Zhabotinski & D. A. Lisichkin. (*C.R. Acad. Sci., U.R.S.S.*, 21st April 1954, Vol. 95, No. 6, pp. 1197–1200. In Russian.) Theory is developed on lines similar to that presented by Post & Bit (1860 of 1951). Results show that the best position for the amplitude-limiting element is in a separate negative-feedback circuit of the amplifier part of the generator, since in other positions the element tends to reduce the frequency and phase stability of the oscillator. At frequencies of a few tens of kilocycles stable amplification of the order of 10^5 can be obtained using a three-stage amplifier with phase-correction circuits. Stable amplification at very high and at very low frequencies is also mentioned.

621.373.421 2890

Generalized Equations for RC Phase-Shift Oscillators.—S. Sherr. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1169–1172.) "General solutions are obtained for three- and four-section phase-shift networks. These solutions are reduced to design equations for a number of specific circuit configurations, and the complete solution is given for a four-section phase-shift oscillator."

621.373.421 2891

Oscillator Feedback Networks of Minimum Attenuation.—P. W. Ward. (*Electronic Engng*, July, 1954 Vol. 26, No. 317, pp. 318–320.) Single-valve oscillators with feedback networks comprising three resistors and three capacitors are discussed. Optimum values for the components are determined by analysis and are plotted as functions of valve output resistance for a given value of valve input resistance. Both shunt-R and shunt-C networks are considered, the former being recommended for very low frequencies and the latter for relatively high ones.

621.373.421.13 2892

Classification of Quartz-Crystal Oscillator Circuits.—H. Awender & K. Sann. (*Funk u. Ton*, April & May 1954, Vol. 8, Nos. 4 & 5, pp. 202–214 & 253–265.) Classification is based on quadripole representation, and two main classes are distinguished according as the circuit is represented by one or two quadripoles in the feedback line. The first class includes II-type networks, subdivided into series-resonance and parallel-resonance circuits, and bridge-type circuits. Variations of the basic circuits are illustrated and formulae are derived for the properties and operating conditions. The main characteristics considered are stabilization factors (see 1274 of 1953 (Kettel)), excitation conditions, operating frequency and crystal loading.

621.373.52 2893

An Amplitude-Stabilized Transistor Oscillator.—E. R. Kretzmer. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, p. 1124.) Correction to paper abstracted in 1352 of May.

621.375.2 : 621.3.015.7 2894

Effect of Steepness of Rise and Fall of the Input Pulse on the Response of Pulse Amplifiers: Part 1.—B. K. Bhattacharyya. (*Indian J. Phys.*, Jan. 1954, Vol. 28, No. 1, pp. 31–47.) Expressions are derived for the response of *RC*-coupled amplifiers to input pulses of ramp form and of triangular form.

621.375.2.029.4 2895

Some Experiments with Miniature Power Triodes.—G. H. Grey. (*Audio*, April 1954, Vol. 38, No. 4, pp. 19–20..61.) Description, including complete circuit diagrams, and discussion of performance of two a.f. amplifiers with an output of about 7.5 W, one of which uses 6AQ5 valves in push-pull and the other four 6S4 valves in parallel in a single-ended output. Using unselected components the latter amplifier gave a more satisfactory performance.

621.375.2.029.424 2896

Selective Special Amplifier for a Frequency of 6·25 c/s.—K. Bauer & W. Haberditz. (*Arch. tech. Messen*, April 1954, No. 219, pp. 89–92.) The design is discussed of a four-stage amplifier for use with a capacitor pickup. Capacitance changes, due to variation of external gas pressure, are $\sim 10^{-6}$–10^{-2}pF in 40 pF. The amplification is sufficient to give an output galvanometer reading for an input of $\sim 2 \times 10^{-5}$–3×10^{-4} V across a 10^9-Ω resistance.

621.375.221 2897

Distributed Amplifier for Nuclear Research.—K. Enslein. (*Electronics*, July 1954, Vol. 27, No. 7, pp. 138–141.) Details, including component values, are given of a four-stage amplifier with input and output impedances of 160Ω; gain is 50–60 db over a bandwidth of 100 Mc/s. Pulses with rise times as short as $4{\cdot}2 \times 10^{-9}$ sec are satisfactorily reproduced. Linearity is good up to 8 V output.

621.375.232 2898

L.F. Compensation for Video Amplifiers: Part 2 — Negative-Feedback Amplifiers.—J. E. Flood. (*Wireless Engr*, Aug. 1954, Vol. 31, No. 8, pp. 214–221.) The method outlined in part 1 (2609 of August) is applied to negative-feedback amplifiers. If β is independent of frequency, the overall response is optimum when the indicial response of the μ path is optimum and the order of compensation is the same. If β is made frequency dependent by including a capacitor in the feedback path, compensation can be obtained which is one order higher than that obtainable from the μ path alone. The method is applied to some simple circuits, including cases where a coupling or a decoupling circuit is outside the feedback loop. Experimental results confirming the theory are reported.

621.375.232.4.029.62 : 621.385.3 : 621.396.822 2899

Study of Noise Reduction by Feedback in Ultra-high Frequency Amplifiers.—A. B. Glenn. (*Trans. Inst. Radio Engrs*, April 1954, No. PGBTR-6, pp. 82–119.) A detailed investigation has been made to determine theoretical and practical limits for the cancellation of valve noise in r.f. amplifiers. Measurements were made on a modified planar type of disk-seal triode designed to have a transit phase angle of about one radian at 120 Mc/s. The conditions for complete noise cancellation are determined and expressions are derived for input

and output admittance, available power gain (W) and noise figure (F). F can be reduced considerably by means of feedback but W is thereby reduced at an equivalent or greater rate, so that the practical application of this method is uneconomical with present valves. The uncorrelated part of the induced grid noise is the most important factor in the increase in F at v.h.f.

621.375.3 2900

Single-Core Magnetic Amplifier Analysis.—M. Frank, S. Rabotnick & J. R. Walker. (*Elect. Engng, N.Y.*, April 1954, Vol. 73, No. 4, p. 336.) Digest of paper to be published in *Trans. Amer. Inst. elect. Engrs, Communication and Electronics*, 1954.

621.375.4 2901

Dissected Amplifiers using Negative Resistance.—W. Shockley & W. P. Mason. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, p. 677.) Possible circuit arrangements of semiconductor devices to give h.f. amplification are discussed, based on segregation of the amplifier properties of negative resistance and directionality. An arrangement of a hexagonal Ge plate with magnetic field perpendicular to its plane and with an appropriate network of resistances corresponds to a pentode amplifier.

621.375.4.029.4 2902

Transistor Application Fundamentals.—R. F. Shea. (*Elect. Engng, N.Y.*, April 1954, Vol. 73, No. 4, pp. 360–365.) A comparison is made of valve and transistor characteristics in relation to a.f. amplifier circuits. The design of a gramophone pickup amplifier using (*a*) the 6SC7 twin-triode and (*b*) 2N43 Ge fused-junction transistors is described; circuit diagrams, characteristic curves and relevant formulae are given.

621.375.5 2903

Resonant Dielectric Amplifier Frequency Response.—G. W. Penney, E. A. Sack & E. R. Wingrove. (*Elect. Engng, N.Y.*, April 1954, Vol. 73, No. 4, p. 311.) Digest of paper to be published in *Trans. Amer. Inst. elect. Engrs, Communication and Electronics*, 1954. Discussion of an amplifier of the type in which the capacitance of a nonlinear capacitor, excited to resonance by a carrier wave, is modulated by a signal voltage and an amplified output is obtained by subsequent demodulation. With a carrier-circuit Q value of 110, the carrier frequency must be of the order of 7 Mc/s for the response to be flat up to signal frequencies of 10 kc/s.

621.376.23 : 538.221 : 538.652 2904

Detection of a Radio Wave by a Ferrite.—J. C. Simon & G. Broussaud. (*C. R. Acad. Sci., Paris*, 14th June 1954, Vol. 238, No. 24, pp. 2294–2296.) A magnetostrictive ferrite rod of 8-mm-square cross-section and length 100 mm was exposed to a u.h.f. field pulsed at 72 kc/s, the third harmonic of the frequency of mechanical resonance of the rod. The 72-kc/s signal was detected by means of a tuned coil located at a mechanical node. The detection process involves (*a*) rectification of the u.h.f. oscillation as a result of the variation of ferrite permeability with applied field, and (*b*) conversion of the rectified signal into a magnetostrictive vibration. Detectors of this type may be useful at wavelengths of 3–10 cm.

621.396.6 : 534.321.9 : 534.213 2905

Characteristics of Ultrasonic Delay Lines using Quartz and Barium Titanate Ceramic Transducers.—J. E. May, Jr. (*J. acoust. Soc. Amer.*, May 1954, Vol. 26, No. 3, pp. 347–355; *Proc. nat. Electronics Conf., Chicago*, 1953, Vol. 9, pp. 264–277.) Equivalent-circuit-based analysis developed previously [2462 of 1952 (Fagen)] is extended to deal with metal delay media and with $BaTiO_3$ as well as quartz transducers. Calculations are made of the decrease in loss due to a decrease in the impedance of the delay medium, and of the increase in bandwidth due to an increase in its impedance.

621.396.6.002.2 2906

Simplifying Fabrication of Printed Circuits.—E. R. Gamson, A. Henesian & R. W. Remington. (*Elect. Mfg*, Feb. 1954, Vol. 53, No. 2, pp. 122–125, 342.) Use of nitric acid in a stencil-etch process reduces production time greatly.

GENERAL PHYSICS

535.37 : 537.533 2907

Comparison between Luminescence and Exo-electron Emission.—J. Kramer. (*Naturwissenschaften*, April 1954, Vol. 41, No. 7, pp. 160–161.) The mechanism and significance of exo-electron emission (2301 of 1953) are investigated by studying the emission of light quanta by luminescence under the same conditions. Parallel effects in the two classes are tabulated and the close relation between the two is established.

535.42 : 538.566] + 534.26 2908

Diffraction by Two Parallel Planes of Finite Length.—W. E. Williams. (*Proc. Camb. phil. Soc.*, April 1954, Vol. 50, Part 2, pp. 309–318.) The diffracting system comprises a pair of parallel perfectly conducting planes of infinite width and finite length l. An incident e.m. wave polarized perpendicular to the edges of the planes is considered; the theory thus applies equally to the diffraction of a plane sound wave. Two integral equations are derived; approximate solutions are obtained for the condition $l \gg \lambda$. An equation is derived giving the value of l for resonance of the system; this is solved approximately and a formula is given for the end correction, i.e., the difference between the resonant length and $n\lambda/2$.

535.42 : 538.566 2909

Diffraction Theory.—C. J. Bouwkamp. (*Rep. Progr. Phys.*, 1954, Vol. 17, pp. 35–100.) A critical review of progress in classical diffraction theory, including references to over 500 papers published since 1940. Both scalar and electromagnetic problems are discussed; the main emphasis is on diffraction by plane obstacles, especially by obstacles small compared with λ.

536.7 : 537.56 2910

Solution of Boltzmann's Equation for a Lorentz Gas: Application to Weakly Ionized Gases.—M. Bayet, J. L. Delcroix & J. F. Denisse. (*C. R. Acad. Sci., Paris*, 31st May 1954, Vol. 238, No. 22, pp. 2146–2148.)

536.8 : 537.226 2911

A Note on the Use of the Titanates as Thermoelectric Transducers.—D. G. Frood. (*Canad. J. Phys.*, April 1954, Vol. 32, No. 4, pp. 313–317.) Approximate calculations for a 75%-25% solid solution of $(Ba\text{-}Sr)TiO_3$ indicate that it would not be useful as a thermoelectric transducer. It seems possible that if materials could be produced with high permittivity and high temperature coefficient of permittivity but independent of field strength, a transducer with an efficiency comparable to that of a steam engine could be developed.

537.213 + 538.123] : 517.947.42 2912

Green's Functions in Evaluating Fields.—J. J. Smith. (*Elect. Engng, N.Y.*, April 1954, Vol. 73, No. 4, p. 323.) Digest of paper to be published in *Trans. Amer. Inst. elect. Engrs, Communication and Electronics*, 1954. Analysis based on the derivation of vector potentials from scalar potentials (2285 of 1953) is extended to

cases in which the field varies with time. An outline is given of the method used to calculate the field due to a current in a conductor. Applications include the calculation of fields in waveguides and resonant cavities.

537.312.8 **2913**

The Magnetoresistance Effect in Metals at High Frequencies.—B. Donovan. (*Proc. phys. Soc.*, 1st April 1954, Vol. 67, No. 412A, pp. 305–314.) The calculation of the effect is based on a model in which the electrons occupy two overlapping partially filled bands of normal form. At low frequencies the relative change in surface resistance is independent of frequency and its variation with field strength is very similar to that observed in d.c. experiments. At high frequencies the effect ultimately drops to zero, the frequency region in which this occurs being determined by the relaxation time. For normal metals it lies in the far infrared. Experimental results for Bi suggest that the relaxation time in Bi is abnormally large.

537.52 **2914**

Current/Voltage Characteristics of a Self-Supporting Gas Discharge in a Transverse Magnetic Field.—R. Haefer. (*Acta phys. austriaca*, April 1954, Vol. 8, No. 3, pp. 213–224.) Continuation of previous work (696 of March). Measurements were made using coaxial-cylinder electrodes with axial magnetic field, in argon at pressures from 10^{-3} to below 10^{-7} Torr. Falling or rising characteristics are obtained according as the pressure is greater or smaller than some thousandths of a Torr. At pressures above this value the discharge has the nature of a glow discharge, with positive space charge. At pressures below this value the characteristics are those of a self-supporting high-vacuum discharge, with negative space charge.

537.525 **2915**

Study of the Induced Electrodeless Discharge in Neon.—F. Cabannes. (*C. R. Acad. Sci., Paris*, 17th May 1954, Vol. 238, No. 20, pp. 1979–1981.) Induction-heating theory is used to study the conductivity in the induced discharge at a frequency of 1 Mc/s.

537.525.029.64 **2916**

On the Radial Extent of Glow in Microwave Gas Discharge between Coaxial Cylinders.—K. Mitani. (*J. phys. Soc. Japan*, March/April 1954, Vol. 9, No. 2, pp. 299–300.) The glow appears in the region of maximum electric field strength close to the central wire, over a radius ~ 1–2 mm. The luminosity depends on the net production rate of electrons per unit volume. This rate is calculated and is shown graphically as a function of radius.

537.527.2 **2917**

Further Research on the Discharge between Positive Point and Plane in Compressed Air or CO_2.—A. Boulloud. (*C. R. Acad. Sci., Paris*, 17th May 1954, Vol. 238, No. 20, pp. 1981–1983.) Continuation of work described previously [3265 of 1953 (Toitot & Boulloud)].

537.533.8 : 546.561 **2918**

Investigation of the Energy Distribution of Secondary Electrons from Single Crystals of Copper Covered with Single-Crystal Layers of Copper Oxide.—N. B. Gornyi. (*Zh. eksp. teor. Fiz.*, March 1954, Vol. 26, No. 3, pp. 327–336.) The secondary electron energy was measured by the retarding-field method. The energy-distribution curve is steeper towards the low-energy side. In the case of polycrystalline Cu covered with polycrystalline Cu_2O one well-defined maximum was observed; in the single-crystal case subsidiary maxima were also found, but the evidence for these is not conclusive. The results are shown graphically.

537.533.8 : 621.387 **2919**

A Reversible Secondary-Emission Fatigue Effect observed in Glow Cathodes comprising a Semiconducting Layer.—W. Kluge & A. Schulz. (*Z. Phys.*, 14th April 1954, Vol. 137, No. 3, pp. 392–400.) If the usual metallic cathode in a glow-discharge tube is replaced by a composite cathode having a semiconducting layer, e.g. an Ag-Cs_2O, (Ag), (Cs)-Cs cathode, the self-maintained discharge current decreases with time, when the current density does not exceed a particular value dependent on cathode geometry, and when the cell is kept in the dark. Recovery takes place slowly, but is speeded up if the cell is subjected to infrared radiation. The effect is ascribed to reversible fatigue of the emission centres for secondary electrons, and the analogous effect observed with photocathodes suggests that both photons and secondary electrons originate in the same emission centres.

538.11 **2920**

Antiferromagnetism.—A. B. Lidiard. (*Rep. Progr. Phys.*, 1954, Vol. 17, pp. 201–244.) A survey paper giving particular attention to Van Vleck's theory and including a discussion of the superexchange mechanism. Papers on experimental investigations are listed by compound and by property studied. Nearly 200 references.

538.242 **2921**

Fisher's Gyromagnetic Effect observed in a Body Placed in a Waveguide.—K. M. Polivanov. (*C. R. Acad. Sci. U.R.S.S.*, 11th April 1954, Vol. 95, No. 5, pp. 969–970. In Russian). The component of magnetization produced in a ferrite perpendicular to the plane of a rotating magnetizing field may be detected in an ellipsoidal specimen placed in a waveguide excited in the H_{01} mode. The theory and experiments which gave negative results were discussed by Fisher (*Proc. roy. Soc. A*, 1st Sept. 1925, Vol. 109, No. 749, pp. 7–27). The effect can be used in determining magnetic fields at very high frequencies.

538.3 **2922**

Interpretation of the Ampère Experiments.—P. Moon & D. E. Spencer. (*J. Franklin Inst.*, March 1954, Vol. 257, No. 3, pp. 203–220.) Ampère's equation for the force between current elements is unique, assuming the correctness of his five postulates. The general equations are here derived that apply if either the third or the fifth postulate is omitted.

538.3 **2923**

The Coulomb Force and the Ampère Force.—P. Moon & D. E. Spencer. (*J. Franklin Inst.*, April 1954, Vol. 257, No. 4, pp. 305–315.) A study of the modification of Coulomb's equation that will satisfy Ampère's experimental results.

538.3 **2924**

A New Electrodynamics.—P. Moon & D. E. Spencer. (*J. Franklin Inst.*, May 1954, Vol. 257, No. 5, pp. 369–382.) A new formulation, alternative to that of Maxwell's equations, is developed from the theories of Weber and of Ritz. The fundamental equation expresses the force on a charged particle caused by another charged particle. For preliminary work see 2922 and 2923 above.

538.56 : 537.562 **2925**

Electromagnetic Properties of Plasmas in a Magnetic Field.—M. Bayet. (*J. Phys. Radium*, April 1954, Vol. 15, No. 4, pp. 258–263.) Continuation of work reported in 1659 of 1953, assuming a constant and uniform magnetic field. Results obtained are discussed in relation to those of other workers, in particular, the matrix for the complex conductivity of an ionized gas, and the dispersion

equation. Previous results apply only for values of gyromagnetic frequency small compared with $(f + i\omega)$, where f is the electron collision frequency and ω the pulsatance of the electric field.

538.566 : 534.21-14 **2926**

Magneto-hydrodynamic Waves in Liquid Sodium.—B. Lehnert. (*Phys. Rev.*, 15th May 1954, Vol. 94, No. 4, pp. 815–824.) Torsional waves in liquid Na have been generated in a cylindrical vessel with the axis parallel to a homogeneous magnetic field, and resonance phenomena have been investigated.

538.566 : 538.614 **2927**

Propagation of Electromagnetic Waves in a Gyrotropic Medium.—M. A. Gintsburg. (*C. R. Acad. Sci. U.R.S.S.*, 1st April 1954, Vol. 95, No. 4, pp. 753–756. In Russian.) Faraday's law of rotation of the plane of polarization is extended to take account of the reflection and refraction at the boundaries of the medium. The relation between path length and the angle of rotation is derived and results for a layer of $MnO.ZnO.2Fe_2O_3$ are shown graphically for a frequency of 2×10^{10} c/s.

538.639. **2928**

Investigation of the Transverse Thermomagnetic Effect.—N. M. Genkin & G. P. Priporova. (*Zh. eksp. teor. Fiz.*, March 1954, Vol. 26, No. 3, pp. 323–326.) The potential difference produced between faces of a conductor perpendicular to the applied magnetic field and perpendicular to the thermal flow was measured and found to be proportional to the magnetization. In weak fields hysteresis is observed; at saturation the potential difference remains constant. A formula similar to that representing the Hall effect is given. The results for low-carbon steel are shown graphically.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.165 **2929**

Theory of Origin of Cosmic Rays.—E. Teller. (*Rep. Progr. Phys.*, 1954, Vol. 17, pp. 154–172.) "It is shown that a random acceleration process, proposed by Fermi, and a physical location of the accelerating fields in radio stars, proposed by Unsöld, account satisfactorily for the main features of cosmic radiation."

523.53 : 621.396.96 **2930**

Radar Determination of the Heights and Radiants of Meteor Showers.—D. W. R. McKinley. (*C. R. Acad. Sci., Paris*, 9th June 1954, Vol. 238, No. 23, pp. 2224–2225.) The technique described by Volmer (713 of March) was used for observations of the Geminids and δ-Aquarids. The results are discussed briefly.

523.755 **2931**

The Physical Condition of the Solar Corona.—C. W. Allen. (*Rep. Progr. Phys.*, 1954, Vol. 17, pp. 135–153.) A review paper including about 70 references.

523.854 : 621.396.822.029.63 **2932**

Probable Observation of the Galactic Nucleus at 400 Mc/s.—R. X. McGee & J. G. Bolton. (*Nature, Lond.*, 22nd May 1954, Vol. 173, No. 4412, pp. 985–987.) Brief report of a survey of the central section of the Milky Way, using an aerial system with a beam width of 2°. In the zone covered from − 17° to − 49° in declination and from 15 hr to 20 hr in right ascension, a strong concentration of brightness was found near a line of galactic latitude − 1° with a maximum centred at 327·9° longitude.

551.508 : 621.398 **2933**

Rocket Instrumentation for Reliable Upper-Atmosphere Temperature Determination.—N. W. Spencer, H. F. Schulte & H. S. Sicinski. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1104–1108.) Electronic telemetry equipment is described, and typical curves are presented showing the variation of pressure and temperature with altitude.

551.510.5 : 621.396.11 **2934**

N.B.S. Research in Radio Propagation.—(See 3018.)

551.510.535 **2935**

Electron Resonance in Ionospheric Waves.—C. O. Hines. (*Nature, Lond.*, 5th June 1954, Vol. 173, No. 4414, pp. 1087–1088.) A new aspect of the investigation of travelling disturbances in the ionosphere is discussed which leads to a more satisfactory interpretation of observational data. The hydrodynamic-wave hypothesis of the earlier work (2655 of 1953) is retained but the observed perturbations in the electron density are attributed to a direct resonance in the electron oscillations regardless of any e.m. fields which may be generated in the process. Formulae are developed for two distinct classes of possible resonant oscillations, one involving and the other not involving a vertical component of propagation. Small-scale disturbances above the F-layer maximum, which have been held responsible for certain radio-star scintillations, could be related to either set of formulae.

551.510.535 **2936**

Some Studies on the Ionospheric Storm.—S. Matsushita. (*Rep. Ionosphere Res. Japan*, Dec. 1953, Vol. 7, No. 4, pp. 161–163.) S_D variations of fE_s and f_oF_2 are tabulated, and the S_D-field current-system computed.

551.510.535 **2937**

Simultaneous Measurement of Sweep Frequency *h'f* and *fof* of the Ionosphere.—Y. Nakata, M. Kan & H. Uyeda. (*Rep. Ionosphere Res. Japan*, Dec. 1953, Vol. 7, No. 4, pp. 129–135.) Outline description of frequency sweep equipment designed to cover the range 1·8–15 Mc/s in four bands and used to obtain simultaneous records of the variation of virtual height and critical frequency with time. Sample records are shown.

551.510.535 **2938**

Global Characteristics of the Separation between the F_1 and F_2-Layers of the Ionosphere.—M. Ghosh. (*Indian J. Phys.*, Aug. 1953, Vol. 27, No. 8, pp. 421–430.) Records of the separation between the F_1 and F_2 layers have been analysed in respect of seasonal and sunspot-cycle variations. The seasonal variations are similar to those observed by Appleton for the height of the F_2 layer (882 of 1951). At high-latitude stations the variation of separation followed the trend of sunspot activity in summer but not in winter. At stations close to the geomagnetic equator the separation varies inversely as sunspot activity in all seasons. The observed variations with season and latitude are consistent with the view that the F_1 and F_2 layers belong to a common bank of ionization. No simple explanation of the variations with sunspot cycle is at present possible.

551.510.535 **2939**

Ionization Distribution in the F Region.—B. Chatterjee. (*Indian J. Phys.*, Feb. 1954, Vol. 28, No. 2, pp. 53–66.) "The height distribution of ionization in the composite F region is calculated on the assumptions that the scale height (i.e. the temperature) increases and the recombination coefficient decreases with height in this region. The recombination coefficient is assumed to vary in terms of the reduced height, that is the height (above F_1 max)

measured in terms of the scale height and not in terms of the actual height as had been done earlier by A. P. Mitra in making similar calculations. The present assumption automatically takes into account the effect of rising temperature on the value of the recombination coefficient. Height distribution curves for high and low latitude stations are drawn for typical summer and winter conditions in the high atmosphere in the F region." When the possible effects of ionospheric tidal drifts are taken into account, the forms of the distribution curves and the separation between the F_1 and F_2 layers agree with those deduced from observations. The results support the view that the F_1 and F_2 layers belong to a common bank of ionization produced by solar radiation.

551.510.535 : 523.78 **2940**

Ionospheric Observation during the Partial Solar Eclipse February 14, 1953.—Y. Nakata. (*Rep. Ionosphere Res. Japan*, Dec. 1953, Vol. 7, No. 4, pp. 157–158.) The critical frequencies of all layers, including the abnormal E layer, are discussed.

551.510.535 : 550.38 **2941**

Polar Magnetic Storms and Geomagnetic Bays: Appendix 1 — A Theory of S_D Field.—N. Fukushima & T. Oguti. (*Rep. Ionosphere Res. Japan*, Dec. 1953, Vol. 7, No. 4, pp. 137–146.) An S_D current system deduced from geomagnetic observations is compared with a system calculated on the dynamo theory, taking anisotropic conductivity of the ionosphere into account. Agreement is fairly good. Conductivity considerations suggest that the S_D current system is located at a height below 150 km.

551.510.535 : 550.384 **2942**

Systematic Investigations of the Influence of Geomagnetic Disturbances on the Daytime F_2-Layer Critical Frequencies.—G. Lange-Hesse. (*Arch. elekt. Übertragung*, April 1954, Vol. 8, No. 4, pp. 143–154.) A statistical analysis has been made of F_2-layer critical frequencies observed at Linden (Harz) during the period December 1947–April 1953, and of geomagnetic observations made at Wingst during the same period. The geomagnetic data were arranged according to the degree of disturbance, and the mean deviations of the critical frequencies corresponding to the different degrees of geomagnetic disturbance were determined. Dependence on sunspot cycle and on season is exhibited. The significance of the results for the prediction of short-wave communication conditions is discussed in detail. Figures are given indicating the reliability of such predictions.

551.510.535 : 550.384 **2943**

On a Change in Geomagnetic Declination accompanying Intense Sporadic-E-Layer Ionization (Supplement).—H. Hojo & T. Yonezawa. (*Rep. Ionosphere Res. Japan*, Dec. 1953, Vol. 7, No. 4, pp. 159–161.) A statistical analysis revealed no relation between intense sporadic-E ionization and lunar diurnal variation of geomagnetic declination, in contradistinction to results for the solar diurnal variation reported in 410 of February.

551.510.535 : 551.55 **2944**

Winds and Turbulent Air Currents in the Ionosphere.—W. Becker. (*Arch. Met. A, Wien*, 16th April 1954, Vol. 6, Nos. 3/4, pp. 417–439.) Predominantly horizontal linear air currents have been observed by direct and indirect methods. The most frequent velocity is 60 m/s at altitudes between 80 and 120 km, and 100 m/s in the F layer, between 200 and 350 km. No uniformity of direction is observed. The results indicate that wind direction and speed depend on time of day and on season as well as on latitude and altitude. The observations confirmed that turbulent currents are superposed on the linear currents in the 80–120 km region, but yielded no corresponding information for the F layer. The occurrence of solar and lunar tides in the E layer, with velocity amplitudes of 35 and 25 m/s respectively, was confirmed. Observations at the greatest possible number of stations are required to enable further conclusions to be reached. 51 references.

551.510.535 : 551.55 **2945**

Horizontal Movements in the Ionosphere.—B. H. Briggs & M. Spencer. (*Rep. Progr. Phys.*, 1954, Vol. 17, pp. 245–280.) A survey of investigation methods and results under the following main headings: reflected radio waves observed at closely spaced points; observations of movements of large-scale irregularities in the F region; observations of waves from radio stars; observations of waves reflected from meteor trails; observations of waves reflected from the sporadic-E layer. The following conclusions are reached: At all levels in the ionosphere systematic as well as irregular horizontal movements are present. Typical velocities are of the order of 80 m/s; there is a tendency for the velocity to increase with height. The systematic movements have the form of regular diurnal and seasonal variations and show considerable consistency between observations made in the Northern and Southern hemispheres. At heights around 100 km the semi-diurnal components of the velocity, as determined by Fourier analysis, are found to represent a uniformly rotating velocity vector; the direction of the rotation is clockwise in the Northern hemisphere and anti-clockwise in the Southern hemisphere. This is the type of movement predicted by the theory of atmospheric oscillations, though the phase of the rotation is not that expected theoretically. At times of magnetic disturbance the velocities of the horizontal movements are increased, and this phenomenon becomes more marked with increasing height in the atmosphere. At 300 km velocities as high as 1 000 m/s have been recorded during magnetic storms. A brief summary of observations by non-radio methods is included. About 40 references.

551.594 **2946**

Anomalous Electric Fields in the Atmosphere.—V. B. Milin. (*C. R. Acad. Sci. U.R.S.S.*, 11th April 1954, Vol. 95, No. 5, pp. 983–986. In Russian.) The potential gradient in the atmosphere was found to depend, to a large extent, on the presence of clouds. The formula derived, which leads to results in good agreement with measurements, expresses the potential gradient at any given height in terms of the known gradients at two other heights, and the three heights.

551.594 **2947**

Atmospheric Electricity.—J. A. Chalmers. (*Rep. Progr. Phys.*, 1954, Vol. 17, pp. 101–134.) A review paper. Aspects of the subject discussed include some in which significant advances have been made since publication of the author's book (98 of 1950) and some on which work was done in Germany during the war. About 100 references.

551.594.6 : 538.566.029.42 **2948**

Observation of Atmospherics at Very Low Frequencies.—W. O. Schumann & H. König. (*Naturwissenschaften*, April 1954, Vol. 41, No. 8, pp. 183–184.) Results of observations, at Munich and several other places, at frequencies in the range 1–25 c/s are correlated with meteorological phenomena. Two main types of waveform were distinguished, one comprising wave trains of duration 0·3–30 sec at a frequency about 9 c/s, the other of a generally nonsinusoidal character at frequencies between 3 and 6 c/s. The former is associated with the presence of a temperature inversion, the latter with low nimbus clouds. The latter type occurred most frequently

one to two days prior to the onset of increased temperatures. Neither type of atmospheric could be observed following the onset of Föhn-type weather.

LOCATION AND AIDS TO NAVIGATION

621.396.932.25 : 621.396.96 **2949**

A Racon Beacon for Reception by Civil Marine Radars.—C. Randall-Cook. (*J. Inst. Nav.*, April 1954, Vol. 7, No. 2, pp. 181–186. Discussion, pp. 190–194.) The beacon is triggered by any radar signal in the 3-cm band at horizon range. On the ship's display, the position of the beacon is identified by a bright radial line starting from the beacon range. Beacon bearing is thus indicated without obscuring the display at closer ranges. No modification to existing marine equipment is required. Beacon equipment comprises a transmitter with frequency sweep over the range 9·320–9·500 kMc/s, a receiver for the same range, and transmitting and receiving aerials having omnidirectional azimuth coverage and 30° vertical coverage to allow for roll and pitch when fitted to a light vessel.

621.396.96 **2950**

False Alarm Time in Pulse Radar.—R. Hollis. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, p. 1189.) Two different definitions of false-alarm time are examined. Though the one definition yields a time 45% longer than the other, the probabilities of one false alarm occurring during these times differ by only about 6%.

621.396.96 : 551.578.1 **2951**

Effect of Attenuation on the Choice of Wavelength for Weather Detection by Radar.—W. Hitschfeld & J. S. Marshall. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1165–1168.) Decreasing the wavelength increases the radar range in clear air but also increases the attenuation due to rain. For the certain detection of operationally significant storms, wavelengths below about 5 cm are unsuitable. See also 2404 of August (Hitschfeld & Bordan).

621.396.96 : 621.396.932.25 **2952**

A Beacon for Ship Identification.—A. L. P. Milwright. (*J. Inst. Nav.*, April 1954, Vol. 7, No. 2, pp. 187–190. Discussion, pp. 190–194.) Ships entering harbour with the assistance of surveillance radar must be identified on the radar display. The ship station for this purpose consists of v.h.f. transponder equipment weighing 23 lb, taken aboard by the pilot. The unit has directive aerials and built-in power supplies with a life of 40 minutes continuous operation. The type of signal chosen is a short radial line passing through the ship range, with a gap in the line at that range. The gap is produced by permitting the beacon klystron to oscillate continuously and using the received signal to stop the oscillation for a period of 12 μs. This beacon is not considered satisfactory for ship-to-ship identification.

621.396.963 **2953**

The Reduction of Sea and Rain Clutter in Marine Radars.—J. Croney. (*J. Inst. Nav.*, April 1954, Vol. 7, No. 2, pp. 175–180. Discussion, pp. 190–194.) For low-definition S-band radar receivers, sea or rain clutter has an amplitude probability distribution of approximately Rayleigh type. When clutter or noise signals are applied to a logarithmic receiver, the r.m.s. amplitude, at the output, of clutter or noise fluctuations about a mean value is constant and independent of that mean value. It is then merely necessary to eliminate the mean value (e.g. by a differentiating circuit) in order to reduce all clutter intensity to the level of the inherent receiver noise. The slope of the receiver logarithmic characteristic must be constant down to about 20 db below r.m.s. noise level. Results on high-definition X-band radar are less good, since the amplitude probability distribution law is not the same.

MATERIALS AND SUBSIDIARY TECHNIQUES

531.788.7 **2954**

A Demountable All-Metal Hot-Cathode Vacuum Ionisation Gauge.—P. K. Dutt. (*Indian J. Phys.*, Jan. 1954, Vol. 28, No. 1, pp. 1–8.) Details are given of the construction and performance of a gauge whose filament can be changed without affecting the operating characteristics.

531.788.7 **2955**

An Ionization Manometer and Control Unit for Extremely Low Pressures.—P. A. Redhead & L. R. McNarry. (*Canad. J. Phys.*, April 1954, Vol. 32, No. 4, pp. 267–274.) A gauge of the Bayard-Alpert type is described, for the measurement of pressures as low as 10^{-10} mm Hg; methods for increasing the sensitivity are discussed.

535.37 **2956**

Intensity of Luminescence of Powdered Luminophors.—A. P. Ivanov. (*Zh. eksp. teor. Fiz.*, March 1954, Vol. 26, No. 3, pp. 275–280.) Theoretical calculation of the dependence of the intensity of luminescence on the degree of dispersion, the binding medium and the thickness of luminescent layer.

535.37 **2957**

Effect of Neutron Bombardment on a Zinc Sulfide Phosphor.—A. W. Smith & J. Turkevich. (*Phys. Rev.*, 15th May 1954, Vol. 94, No. 4, pp. 857–865.) Luminescence efficiency after bombardment decreased for all conditions of temperature, the effect being more pronounced the longer the period of neutron irradiation. The emission spectrum was practically unchanged. Bombardment changes neither the permittivity nor its dependence on excitation light intensity.

535.37 : 061.3 **2958**

Luminescence of Inorganic Phosphors.—G. F. J. Garlick. (*Nature, Lond.*, 5th June 1954, Vol. 173, No. 4414, pp. 1077–1078.) Brief account of the proceedings of a conference held at Cambridge in April 1954.

535.37 : 537.228 **2959**

New Effect of Sensitization of Luminescent Substances to X Rays by Electric Fields.—M. Destriau. (*C. R. Acad. Sci., Paris*, 14th June 1954, Vol. 238, No. 24, pp. 2298–2300.) In contrast to the quenching effect described by G. Destriau (*J. Phys. Radium*, 1943, Vol. 4, p. 32) certain mixtures of ZnS and CdS when excited by X rays exhibit an increase of luminescence on application of an electric field. The same mixtures exhibit the usual quenching effect when excited by ultraviolet rays.

535.37 : 537.529 : 546.482.21 **2960**

Electric Breakdown and Light Emission in CdS Single Crystals.—G. Diemer. (*Philips Res. Rep.*, April 1954, Vol. 9, No. 2, pp. 109–121.)

535.376 **2961**

New Manganese-Activated Fluoride Phosphors.—A. L. Smith. (*J. electrochem. Soc.*, April 1954, Vol. 101, No. 4, pp. 189–194.) "The following manganese-activated fluorides were found to exhibit efficient cathodoluminescence: $NaZnF_3$, $KZnF_3$, K_2ZnF_4, $NaMgF_3$, $KMgF_3$, K_2MgF_4, CaF_2, $KCaF_3$, $KCdF_3$, and the solid solutions formed between CaF_2 and AlF_3."

535.376 : 546.472.21 **2962**

Electroluminescent ZnS Phosphors.—P. Zalm, G. Diemer & H. A. Klasens. (*Philips Res. Rep.*, April 1954, Vol. 9, No. 2, pp. 81–108.) An account is given of the preparation of a ZnS phosphor with a copper-rich layer on the surface of the grains. Electrical and optical measurements made on such phosphors are described; voltage/current and voltage/light-output oscillograms for suspended and binderless settled layers are shown. The maximum efficiency is 1·5 + 0·2 lm/W, the brightness at 600 V, 3 kc/s is ~ 1 000 lm/m². The hypothesis of a barrier action at the grain surface was confirmed. Results of observations lead to the conclusion that electroluminescence is similar to cathodoluminescence with 'slow' electrons. The low efficiency of electroluminescent phosphors is compared with that of normal phosphors under cathode-ray excitation at low voltage and high current density. An equivalent circuit for a suspended electroluminescent layer is discussed.

537.226.33 + 539.389.3 **2963**

Dielectric Hysteresis and Elastic After-Effect.—J. Granier & P. Caillon. (*C. R. Acad. Sci., Paris*, 9th June 1954, Vol. 238, No. 23, pp. 2232–2233.) The relations between the two effects were investigated by measurements on polyvinyl chloride. Delay intervals studied ranged from 5 to 2 000 sec, and temperatures covered the whole range of states of viscoelasticity of the substance. The results indicate different and independent origins for the two effects over the time intervals studied.

537.227 **2964**

Theory of Ferroelectrics.—A. F. Devonshire. (*Advances Phys.*, April 1954, Vol. 3, No. 10, pp. 85–130.) Ferroelectric substances are defined and classified, their physical constants, their properties near the transition temperature, and the relation of their macroscopic properties to atomic structure are examined.

537.227 : 547.476.3 **2965**

Nature of Ferroelectricity in Rochelle Salt.—K. N. Karmen. (*Zh. eksp. teor. Fiz.*, March 1954, Vol. 26, No. 3, pp. 370–376.) Results of an experimental investigation of the charging and discharging of a capacitor with the salt as dielectric indicate that the time lags observed are not due to an intermediate layer between the electrodes and the dielectric, nor can they be explained in terms of the usual theory of ferroelectricity. The results of measurements at temperatures between about − 18°C and + 20°C and at field strengths up to 280 V/cm are shown graphically.

537.311.3 **2966**

Electrical Conduction in Halide-Contaminated Ice.—E. J. Workman, F. K. Truby & W. Drost-Hansen. (*Phys. Rev.*, 15th May 1954, Vol. 94, No. 4, p. 1073.) Halide-contaminated ice, frozen in a prescribed way, has the following characteristics: (*a*) it acts as a rectifier, (*b*) it has an extremely high permittivity for fields applied in the inverse direction, and (*c*) the conductive and dielectric properties depend in a complicated way upon temperature, bias, and frequency. Experiments show that the conduction process is ionic, involving a proton transfer mechanism.

537.311.33 : 535.215 **2967**

Kinetics of the Formation and Relaxation of Non-equilibrium Current Carriers on Illumination of a Semiconductor.—E. I. Adirovich & V. G. Kolomiiova. (*Zh. eksp. teor. Fiz.*, March 1954, Vol. 26, No. 3, pp. 281–292.) A theoretical investigation for a semiconductor with bipolar conductivity. Solutions are found for a uniform layer, as solution of a linearized problem in a general form and in asymptotic forms for given boundary conditions. The stationary carrier-distribution is also determined. The conditions under which the linearized equations are applicable and their connection with the requirement of quasi-neutrality are discussed.

537.311.33 : 536.21 **2968**

On the Thermal and Electrical Conductivity of Semiconductors.—H. J. Goldsmid. (*Proc. phys. Soc.*, 1st April 1954, Vol. 67, No. 412B, pp. 360–363. Correction, *ibid.*, No. 415B, p. 599.) The relation between electron mobility μ and thermal conductivity λ is investigated for high-purity semiconductors, for which it may be assumed that scattering is entirely due to lattice vibrations and that thermal current is carried solely by elastic waves. Theory indicates a rapid rise of μ/λ with atomic weight; this is borne out by observations.

537.311.33 : 539.231 : 546.48-31 **2969**

Irreversible Changes in Electron Mobility in Thin CdO Films.—F. Lappe. (*Z. Phys.*, 14th April 1954, Vol. 137, No. 3, pp. 380–382.) For films sputtered in air or in argon-oxygen mixtures, and heated in air, the variation of conductivity measured over the temperature range 20°–700°C is irreversible and the conductivity exhibits a minimum around 270°C. Hall-effect measurements show that this is due to a minimum in electron mobility. This minimum is not observed for films heated in vacuum.

537.311.33 : 539.231 : 546.48-31 **2970**

Optical Absorption and Electrical Properties of CdO Films with Many Lattice Imperfections.—H. Dunstädter. (*Z. Phys.*, 14th April 1954, Vol. 137, No. 3, pp. 383–385.) In addition to the electrical measurements reported in 2969 above, optical absorption measurements were made on the same films. Results show that the extinction coefficient decreases as the electron concentration increases.

537.311.33 : 546.23 **2971**

A Macrostructure of Amorphous Selenium.—J. Weber. (*Z. Naturf.*, Sept. 1953, Vol. 8a, No. 9, pp. 565–566A.) The conditions are discussed under which evaporated layers of amorphous Se exhibit simulated crystal structure. Photographs at various magnifications illustrate the effect.

537.311.33 : 546.23 **2972**

Electrical Resistivity of Polycrystalline Selenium at Higher Fields.—M. Kuwagata, E. Otsuka & M. Tomura. (*J. phys. Soc. Japan*, March/April 1954, Vol. 9, No. 2, pp. 300–301.) Measurements were made on a specimen annealed at ~ 180°C for 10 minutes, using electric fields of up to 22 kV/cm applied in 7-μs pulses at a repetition rate of 60/sec. The resistivity/field-strength characteristic obtained fits the Schottky plot at temperatures of 40°, 67° and 100°C. The variation of resistance with frequency up to 20 Mc/s is shown graphically. For specimens containing 0·05% of iodine, the resistivities are lower by a factor of 10^2–10^3 than those for a pure sample.

537.311.33 : 546.28 : 537.529 **2973**

Avalanche Breakdown in Silicon.—K. G. McKay. (*Phys. Rev.*, 15th May 1954, Vol. 94, No. 4, pp. 877–884.) Theory is based on the assumption of approximately equal ionization rates for electrons and holes. The problem of determining ionization rates from data obtained in inhomogeneous fields is solved exactly for junctions in which the impurity concentration varies (*a*) abruptly, and (*b*) gradually, from *p* to *n* type. Ionization rates thus calculated from experimental data on breakdown voltage and on pre-breakdown multiplica-

tion are in good agreement in both cases. The temperature coefficient of the ionization rate exhibits a similar internal consistency. Breakdown in Si may therefore be regarded as a direct result of multiplication by collision. Detailed observations of the pulse-type noise associated with the onset of breakdown are reported.

537.311.33 : 546.289 **2974**

Interferometric Observation of Mosaic Structure on the (111) Face of a Single Crystal of Germanium.—A. R. Verma. (*Proc. phys. Soc.*, 1st April 1954, Vol. 67, No. 412B, pp. 359–360.)

537.311.33 : 546.289 **2975**

Hall Coefficient in Germanium.—T. C. Harman, R. K. Willardson & A. C. Beer. (*Phys. Rev.*, 15th May 1954, Vol. 94, No. 4, pp. 1065–1067.) By carrying out measurements in strong magnetic fields and using the equations valid in the limiting cases of such fields, mobility values were obtained for *p*-type Ge in good agreement with drift-mobility measurements. The extrinsic Hall coefficient determined in strong magnetic fields remains relatively constant with decreasing temperature.

537.311.33 : 546.289 **2976**

High-Field Effects in Germanium.—E. M. Conwell. (*Phys. Rev.*, 15th May 1954, Vol. 94, No. 4, p. 1068.) The experimental results of Ryder (3326 of 1953), interpreted by him as due to an increase in mobility, were alternatively explained by Sclar et al. (*Phys. Rev.*, 1953, Vol. 92, p. 858) as due to impact ionization of neutral donors by hot electrons. An experimental check is suggested.

537.311.33 : 546.289 **2977**

Volume and Surface Recombination Rates for Injected Carriers in Germanium.—J. P. McKelvey & R. L. Longini. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, pp. 634–641.) Recombination is studied, using experimental technique described by Navon et al. (740 of 1953). Diffusion theory is developed, taking account of reflection of carriers at the surfaces of the sample. A simple relation is derived between the reflection coefficient and the surface recombination velocity. Values of bulk lifetime and surface recombination velocity are determined for *p*-type and *n*-type samples, for various surface treatments.

537.311.33 : 546.289 **2978**

Temperature Dependence of the Surface Recombination Velocity in Germanium.—Y. Kanai. (*J. phys. Soc. Japan*, March/April 1954, Vol. 9, No. 2, pp. 292–293.) The surface recombination velocity determined from measurements of the Suhl effect in *n*-type Ge is given as a function of temperature in the range from about −30°C to +60°C. A tentative value of 0·35 eV is given for the energy level of the surface traps below the conduction band.

537.311.33 : 546.289 : 621.314.632 **2979**

Blocking Contacts between Germanium and Evaporated Metal Films.—H. U. Harten. (*Naturwissenschaften*, April 1954, Vol. 41, No. 7, p. 162.) Measurements were made of the differential capacitance of rectifying contacts prepared by evaporating Au or Cu on to previously etched Ge disks. The variation with applied blocking voltage agrees qualitatively but not quantitatively with that expected from theory. The rate of variation appears to depend not only on the impurity concentration but also, in a manner not yet understood, on the state of the Ge surface.

537.311.33 : 546.46-31 **2980**

Some Optical Properties of MgO in the Vacuum Ultraviolet.—P. D. Johnson. (*Phys. Rev.*, 15th May 1954, Vol. 94, No. 4, pp. 845–846.) "The optical absorption and the excitation spectrum for luminescence of synthetic periclase crystals have been determined in the vacuum ultraviolet. From these measurements it is deduced that the width of the forbidden energy band of MgO is approximately 7·4 eV."

537.311.33 : 546.682.86 **2981**

The Electrical Properties of Indium Antimonide at Low Temperatures.—J. Hatton & B. V. Rollin. (*Proc. phys. Soc.*, 1st April 1954, Vol. 67, No. 412A, pp. 385–386.) Measurements were made on polycrystalline specimens over the temperature range 300°–1°K. Hall coefficient and magnetoresistance are very small at the lowest temperatures.

537.311.33 : [546.817.231 + 546.817.241 **2982**

Electrical Properties of Single Crystals and Thin Films of PbSe and PbTe.—S. J. Silverman & H. Levinstein. (*Phys. Rev.*, 15th May 1954, Vol. 94, No. 4, pp. 871–876.) Thin films were formed by evaporating single crystals without exposure to air. Measurements were made in the temperature range 300°–77°K. All films were *n* type, whether the original crystal was *n* or *p* type. Carrier mobilities in films were markedly affected by substrate temperature during film formation, subsequent annealing, and limited oxygenation; room-temperature mobilities in annealed films were about $\frac{1}{3}$ of the bulk values.

538.221 **2983**

Surface Magnetic Anisotropy and Superlattices formed by Orientation.—L. Néel. (*J. Phys. Radium*, April 1954, Vol. 15, No. 4, pp. 225–239.) Theory showing the relation between these two effects is applied, in particular, to the interpretation of the phenomena observed by Rathenau & Snoek (3428 of 1948).

538.221 **2984**

Initial Complex Magnetic Permeability of Iron from 0 to 7 000 Mc/s.—J. Benoit & E. Naschke. (*C. R. Acad. Sci., Paris*, 14th June 1954, Vol. 238, No. 24, pp. 2292–2294.) Permeability measurements were made on Armco wire treated in various ways. For a specimen treated to produce large domains, magnetic dispersion starts at a frequency of about 5 Mc/s, i.e. well below the frequency at which electron spin rotation is effective. This enables the experimental results to be used as a check against Néel's theory of the movements of domain walls.

538.221 **2985**

On the g-Factor and H_i of Nickel Ferrite-Aluminate.—Y. Torizuka, Y. Kojima & T. Fujimura. (*J. phys. Soc. Japan*, March/April 1954, Vol. 9, No. 2, pp. 298–299.) A note giving the results of experimental determinations of the g factor at 19·23 kMc/s and 28·85 kMc/s, taking account of the internal magnetic field.

538.221 **2986**

Cation Distributions in Mixed Ferrites.—J. S. Smart. (*Phys. Rev.*, 15th May 1954, Vol. 94, No. 4, pp. 847–850.) Expressions are derived for the equilibrium distribution of cations in mixed ferrites having three different kinds of metallic ions, in terms of magnetic moment and g factor. For nickel ferrite aluminates the results agree reasonably well with X-ray diffraction data.

538.614 : [621.318.124 + 621.318.134 **2987**

Faraday Effect in Magnetic Materials with Travelling and Standing Waves.—H. G. Beljers. (*Philips Res. Rep.*,

April 1954, Vol. 9, No. 2, pp. 131–139.) The measurement of Faraday rotation at 9·4 and 24 kMc/s in ferroxcube and in ferroxdure cylinders in circular waveguides is described. The effect was also demonstrated by the splitting up of the resonance curve of a cavity resonator at one end of which was placed a thin disk of ferroxcube IV subjected to a variable magnetic field.

538.652 **2988**

The Approach to Saturation Magnetostriction.—E. W. Lee. (*Proc. phys. Soc.*, 1st April 1954, Vol. 67, No. 412A, pp. 381–383.) Magnetostriction of a polycrystalline specimen is given in terms of the external field, H, by $(A + BH^{-1} + CH^{-2} + \ldots)$. The conditions under which the term in H^{-2} is of real importance are discussed.

546.311.12 **2989**

Color Centers in Alkali Halide Crystals: Part 2.—F. Seitz. (*Rev. mod. Phys.*, Jan. 1954, Vol. 26, No. 1, pp. 7–94.) A survey of progress since 1946.

548.55 : 546.289 **2990**

Cross-Section of Pulled Crystals.—R. H. Pohl. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, pp. 668–669.) From considerations of mechanical and thermal equilibrium at the liquid/solid interface, an expression is derived for the radius of a crystal grown by the Czochralski technique. The values obtained are compared with experimental results for Ge crystals.

621.318.23 : 621.385.029.6 **2991**

Calculation of Permanent Magnets of 'Tubular' Form.—M. de Bennetot. (*Ann. Radioélect.*, April 1954, Vol. 9, No. 36, pp. 193–216.) The design of magnets for focusing the beams of u.h.f. valves is considered. A procedure based on the equivalence between the magnet and a system of fictitious magnetic masses is studied. From the geometry of the system and the demagnetization characteristic of the material, the field along the axis of revolution is determined by means of a relaxation method. Calculated values are in good agreement with values found experimentally.

621.319.4 : 621.793 **2992**

The Zinc Coating of Paper for Capacitors by Vacuum Evaporation.—L. Holland & K. Hacking. (*Electronic Engng*, July 1954, Vol. 26, No. 317, pp. 296–301.) An account is given of the development of equipment and technique for producing the low gas pressure required for metallizing volatile materials such as capacitor tissue. Zn can be evaporated at higher rates and at higher gas pressures than Al, but when using Zn it is necessary to pre-coat the paper with nucleating film, e.g. Ag monolayer. To avoid oxidation of the Zn coating, the paper must be thoroughly pre-dried.

MATHEMATICS

517 **2993**

New Formulas for Facilitating Osculatory Interpolation.—H. E. Salzer. (*J. Res. nat. Bur. Stand.*, April 1954, Vol. 52, No. 4, pp. 211–216.) Hermite's n-point osculatory interpolation formula for equally spaced arguments, employing the function and its derivative, is expressed in a form which reduces the amount of labour required to calculate the coefficients.

517.564.3 **2994**

Asymptotic Expansions of Bessel Functions in the Transition Regions.—M. Nagase. (*J. phys. Soc. Japan*, March/April 1954, Vol. 9, No. 2, pp. 296–297.) Formulae are derived for Bessel functions of the third kind.

517.6 **2995**

On the Computation of Oscillatory Integrals.—Y. L. Luke. (*Proc. Camb. phil. Soc.*, April 1954, Vol. 50, Part 2, pp. 269–277.) Integrals of the type $\int_a^b f(y)e^{i\lambda y}dy$ are considered. Formulae are presented which enable the integral to be easily evaluated for any λ when $f(y)$ is tabulated.

MEASUREMENTS AND TEST GEAR

621.317 : 621.396.828 **2996**

Measurements and Standards for Control of Spurious Radiation.—Bailey. (See 3026.)

621.317.3 : 621.396.822 **2997**

Errors in Power Spectra Due to Finite Sample.—L. M. Spetner. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, pp. 653–659.) "An estimate is made of the accuracy with which the 'spectrum' of a finite sample of Gaussian noise approximates the spectrum of the original noise from which the sample was taken. The sample is considered to be spliced to form an endless loop, thereby making it a periodic function. The effect of this splice is also discussed."

621.317.326.029.63 **2998**

A Theory of the Diode Voltmeter for Measurement of Pulse Power at Pulsed High Frequency in the Decimetre-Wave Range.—L. Kühn. (*Frequenz*, April 1954, Vol. 8, No. 4, pp. 103–112.) Based on an analysis for continuous waves, the value of load resistance for equilibrium in a peak-voltmeter circuit with pulsed operation is determined. By considering an 'ideal' capacitor charging characteristic which takes account of the discharge between pulses, the analysis is extended to determine charging time. The degree of rectification is almost completely dependent on the value of the parallel load resistance, which should be of the order of $10^{10}\Omega$. The problem of insulating circuit components is briefly considered.

621.317.336 : 621.317.755 **2999**

Indication and Measurement of the Argument and Modulus of an Impedance by means of the Cathode-Ray Oscilloscope.—V. Popovic. (*Onde élect.*, April 1954, Vol. 34, No. 325, pp. 376–380.) A simple circuit is described by means of which a direct reading in polar coordinates, accurate to within about 1%, is obtained on the screen. The method is applicable over a wide range of frequencies. Experimental results support the theory given.

621.317.34.029.64 + 621.372.2 **3000**

An Experimental Investigation of the Single-Wire Transmission Line.—Roberts. (See 2849.)

621.317.35 : 621.311.62 **3001**

Progress in the Measurement of Mains Harmonics.—W. Grunert. (*Arch. tech. Messen*, April 1954, No. 219, pp. 77–80.) The application of dynamometer and resonance methods to measurement of odd harmonics up to the 27th is briefly discussed. The errors in the latter method caused by a strong fundamental, by mains frequency variations and by interference are considered and formulae for estimating them are given.

621.317.4 **3002**

Recording Fluxmeter.—R. I. Berge & C. A. Guderjahn. (*Electronics*, July 1954, Vol. 27, No. 7, pp. 147–149.) An arrangement for the rapid plotting of B/H curves of ring specimens is described. The ring has two windings, one carrying a variable current supply and the other

acting as search coil. Movement of the recorder pen in one direction is made proportional to the supply current and in the perpendicular direction to the flux in the specimen; a galvanometer with photocell bridge and amplifier is used. The overall error can be kept within 0·5% ± 25 interlinkages/minute.

621.317.7 **3003**

Inductance and Dynamic Resistance Meter.—G. G. Johnstone. (*Wireless World*, Aug. 1954, Vol. 60, No. 8, pp. 377–381.) An instrument developed for comparing the performances of inductors used in medium-wave receivers is described. The principle used is to feed a current of known value from an effectively infinite-impedance source to the tuned circuit comprising the inductor and tuning capacitor in parallel. A pentode valve is used as the constant-current generator.

621.317.715.044.6 : 538.12 **3004**

An Application of Conformal Transformation to the Investigation of the Magnetic Field between Galvanometer Pole-Pieces.—W. Snowdon & N. Davy. (*Brit. J. appl. Phys.*, April 1954, Vol. 5, No. 4, pp. 146–151.) An accurate calculation is made of the magnetic potential, the associated stream function and the strength of the magnetic field along the boundary and axes of symmetry of a figure which represents the cross-section of the two pole-pieces and central core of a galvanometer. The field strength between the core and pole pieces is also determined. An extension of the Schwarz-Christoffel transformation is used. Results are tabulated and shown graphically.

621.317.72/.73 **3005**

Electronic Test Meter.—M. G. Scroggie. (*Wireless World*, Aug. 1954, Vol. 60, No. 8, pp. 371–376.) An instrument for the measurement of direct and alternating voltage and resistance is based on a combination of two valve-voltmeter designs previously described (1041 and 1671 of 1952).

621.317.723 **3006**

Stabilization of the Response of a Tetrode Electrometer Valve with respect to Variation of the Heating Voltage by Negative Feedback on the Cathode.—D. Malé. (*C. R. Acad. Sci., Paris*, 17th May 1954, Vol. 238, No. 20, pp. 1977–1979.) By connecting a resistance of appropriate magnitude in the cathode lead and tapping it off a suitable point on a voltage divider, the potential difference between the cathode and the control grid is automatically varied with variation of the heating voltage so as to maintain constant galvanometer current.

621.317.738 **3007**

An Instrument for Direct Measurements of Capacitance and Power Factor.—J. C. Bhattacharya. (*Indian J. Phys.*, Feb. 1954, Vol. 28, No. 2, pp. 75–84.) Capacitances up to 0·02 μF are measured by means of an instrument whose operation is based on the variation of the frequency and Q value of a tuned circuit when the capacitance is connected across it.

621.372.8.001.4 : 621.372.56 **3008**

Precision [rectangular-] **Waveguide Attenuator.**—W. W. H. Clarke & C. W. K. Maysmor. (*A.T.E. J.*, April 1954, Vol. 10, No. 2, pp. 114–119.) The attenuating element is a resistive vane which is moved across the guide by a micrometer head, and which gives up to 60 db attenuation. The vane is of glass coated with a thin evaporated nichrome film, and protected by a MgF_2 layer. The ends are tapered for a distance of half the mean guide wavelength for the band concerned. Repeated calibration shows reasonable stability of readings.

621.397.6.001.4 **3009**

Synthetic-Pattern Generator for the Solution of Certain Instrumentation Problems in Television.—R. C. Webb. (*RCA Rev.*, June 1954, Vol. 15, No. 2, pp. 187–203.) Detailed description of a generator capable of providing a comprehensive range of test patterns for television testing.

621.397.62.001.4 : 621.397.8 **3010**

Factors affecting the Correlation of TV Picture Quality between Field and Laboratory Signals.—B. Amos & C. Quirk. (*Trans. Inst. Radio Engrs*, April 1954, No. PGBTR-6, pp. 2–16.) Discussion of test procedures in relation to receiver design and in particular to the mass production of receivers with uniformly good performance under widely varying conditions. Overall gain, selectivity, phase and amplitude response, and rise time of the video circuits are considered. Conveyor-system test arrangements are described and illustrations of test patterns and c.r.o. traces are shown.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

534.15 **3011**

An Acoustic Method for the Measurement of Vibration Amplitudes.—W. Koidan. (*J. acoust. Soc. Amer.*, May 1954, Vol. 26, No. 3, pp. 428–433.) "By means of a modification of the pistonphone, a technique has been developed to obtain the response of a capacitance-type vibration pickup probe using the reciprocity calibration of a condenser microphone as a reference."

534.321.9 : 621.375.2 **3012**

Distributed Transducer for Ultrasonic Power.—J. Rabinow & M. Apstein. (*Electronics*, July 1954, Vol. 27, No. 7, pp. 160–162.) A device for generating high-amplitude ultrasonic oscillations comprises a distributed amplifier with a magnetostrictive bar associated with the output. The electrical delay line is designed so that the velocity of propagation in it matches the velocity of the ultrasonic waves set up in the bar. Possible applications are indicated.

621.384.611 **3013**

Microtrons (Electron Cyclotrons) for X and K Band Operation.—H. F. Kaiser. (*J. Franklin Inst.*, Feb. 1954, Vol. 257, No. 2, pp. 89–108.) Design principles are discussed, and performance details given for two models operating in the 3-cm band.

621.384.612 **3014**

The Effect of Field Bump in a Strong-Focusing Synchrotron.—K. Huke & G. Iwata. (*J. phys. Soc. Japan*, March/April 1954, Vol. 9, No. 2, pp. 297–298.) Calculation of the effect due to the field bump and the form factor.

621.384.622 **3015**

Transverse Motion of an Electron in a Constant-Wave-Speed Section of a Linear Accelerator.—I. Jacobs & E. S. Akeley. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, pp. 572–576.)

PROPAGATION OF WAVES

538.566.029.61 : 535.22 **3016**

Investigation of a New Form of Microwave Interferometer for Determining the Velocity of Electromagnetic Waves.—K. D. Froome. (*Proc. roy. Soc. A*, 22nd April 1954, Vol. 223, No. 1153, pp. 195–215.) A sensitive symmetrical interferometer using two fixed horn

radiators, approximately 8 m apart, and a carriage-mounted two-horn detector and indicator is described and its application to the measurement of wavelength, and hence phase velocity, is discussed. Results of preliminary measurements at 24·005 kMc/s give $c_0 = 299\,793{\cdot}0 \pm 0{\cdot}3$ km/s, the error limit given representing the standard deviation of single observations in statistical combination with systematic errors due to scattering, etc. The correction of errors due to diffraction and distortion of the wavefronts was investigated in detail.

621.396.11 **3017**

Coupled Forms of the Differential Equations governing Radio Propagation in the Ionosphere.—P. C. Clemmow & J. Heading. (*Proc. Camb. phil. Soc.*, April 1954, Vol. 50, Part 2, pp. 319–333.) The equations for oblique propagation in a horizontally stratified ionosphere with an oblique magnetic field are put in a form suitable for solution by successive approximations. In the general case this 'coupled' form consists of four first-order differential equations, each associated with one characteristic wave. In the special cases of (*a*) horizontal magnetic field, and (*b*) plane of incidence perpendicular to magnetic meridian, two second-order coupled equations of a particular type can be derived, each associated with a pair of corresponding upgoing and downgoing characteristic waves. These latter equations include those given previously by Försterling (1884 of 1942) for vertical incidence. Cases in which there is no coupling are briefly considered from the point of view of the first-order equations. The general formulation provides a basis for assessing the validity of the standard 'ray' approximation, alternative to that developed by Booker (3277 of 1936), and brings out the nature of its breakdown in coupling and reflection regions.

621.396.11 : 551.510.5 **3018**

N.B.S. Research in Radio Propagation.—(*Tech. News Bull. nat. Bur. Stand.*, April 1954, Vol. 38, No. 4, pp. 49–59.) A brief review of the work of the Central Radio Propagation Laboratory, which has four main divisions: (*a*) the Ionosphere Research Laboratory, whose investigations include solar r.f. radiation, upper-atmospheric winds, etc.; (*b*) the Systems Research Laboratory, which is concerned with tropospheric propagation and with research on the best use of the frequency spectrum; (*c*) the Measurements Standards Laboratory, which is responsible for the standard-frequency broadcasts from WWV and WWVH; (*d*) the propagation prediction services.

621.396.11.029.55 : 551.510.535 **3019**

Sweep Frequency Backscatter — Some Observations and Deductions.—R. Silberstein. (*Trans. Inst. Radio Engrs*, April 1954, Vol. AP-2, No. 2, pp. 56–63.) Detailed analysis of records taken during two periods in December 1952 and January 1953. "In one group of observations over a 1 150-km path on three undisturbed days, the values of F_2-layer maximum usable frequency scaled from midpoint vertical-incidence ionospheric records and those determined by backscatter delay assuming ground scatter agreed almost within experimental error. In another three-day group characterized by a low-latitude ionospheric disturbance with low geomagnetic K indexes but considerable sporadic E activity, values of m.u.f. determined from scatter were much too high under the ground-scatter assumption, errors of about 30% being not uncommon." The distant scatter in this case appears to originate at the E layer.

621.396.8 **3020**

The Statistical Distribution of Field Strength of Radio Signals propagated in the Troposphere and in the Ionosphere.—L. Sacco. (*Poste e Telecomunicazioni*, Feb. 1954, Vol. 22, No. 2, pp. 55–72.) An examination is made of the types of distribution in time which best represent the fluctuations of radio signals traversing the troposphere and the ionosphere. The distributions considered are (*a*) normal, (*b*) log normal, (*c*) fluctuations due to interference (Rayleigh distribution) and (*d*) fluctuations due to polarization variations. Gamma and phase distribution are discussed and the concept of correlation is introduced.

621.396.812.3.029.55 : 551.510.535 **3021**

Ionosphere and Nature of Fading Patterns of Received Radio Signals.—R. N. Singh. (*Indian J. Phys.*, March 1954, Vol. 28, No. 3, pp. 109–118.) Records of reception of s.w. transmissions from Indian and other stations are analysed and compared with theoretical curves derived from Rayleigh's probability formula. A study is made of (*a*) variations of the nature of fading with time of day for a given signal frequency and transmitter distance, and (*b*) variation of the nature of fading with transmission distance for a given frequency at different times of day. The results indicate that the fading pattern is at least partially determined by the electron density in the region of the ionosphere at which the received waves are reflected.

RECEPTION

621.396.621 : 621.314.7 **3022**

An Experimental Transistor Personal Broadcast Receiver.—L. E. Barton. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1062–1066.) See 2206 of July.

621.396.621 : 621.385.2 **3023**

Vacuum-Tube Detector and Converter for Microwaves using Large Electron Transit Angles.—Bronwell, Wang, Nitz, May & Wachowski. (See 3096.)

621.396.621 : 621.396.822 : 621.372.54 **3024**

The Detection of a Sine Wave in the Presence of Noise by the Use of a Nonlinear Filter.—T. G. Slattery. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, p. 1124.) Discussion on 206 of 1953.

621.396.82 : 621.397.62 **3025**

Spurious Radiation from TV Receivers.—Chittick. (See 3062.)

621.396.828 : 621.317 **3026**

Measurements and Standards for Control of Spurious Radiation.—S. L. Bailey. (*Trans. Inst. Radio Engrs*, April 1954, No. PGBTR-6, pp. 59–64.) Critical discussion of existing F.C.C. regulations relating to interfering radiation. Specifications based on attenuation below unmodulated-carrier level are inconsistent with field-strength specifications applying to systems intended to be nonradiating. Two examples illustrate practical aspects of accurate field-strength measurement.

STATIONS AND COMMUNICATION SYSTEMS

621.376 : 621.396.65 **3027**

Comparison of Code and Classical Types of Modulation.—J. P. Vasseur. (*Ann. Radioélect.*, April 1954, Vol. 9, No. 36, pp. 137–149.) Various known systems, including p.c.m. and delta modulation with single and double integration, are reviewed with the object of determining which is most suitable in given circumstances. Use of the code systems may enable very difficult links to be operated satisfactorily, but in most cases carrier-current, p.a.m. or p.p.m. systems afford satisfactory operation with greater economy, both financially and from the point of view of bandwidth.

621.376.2 **3028**

A General Solution of the Two-Frequency Modulation Product Problem: Part 2 — Tables of the Functions $A_{mn}(h,k)$.—R. L. Sternberg. (*J. Math. Phys.*, April 1954, Vol. 33, No. 1, pp. 68–79.) Methods and tables are presented for evaluating functions discussed in part 1 [2212 of July (Sternberg & Kaufman)].

621.376.5 : 621.396.41 **3029**

'Elastic' Pulse Modulation.—F. J. Tischer. (*Fernmeldetech. Z.*, April 1954, Vol. 7, No. 4, pp. 187–189.) The term 'elastic pulse modulation' is used to designate a particular system in which quantization of the signal is performed at both transmitter and receiver. The operation is described by comparing it with an ordinary p.p.m. system in which the transmitter pulses are produced by superposing the modulation voltage on a sawtooth voltage, while at the receiver the incoming pulses are used to gate a valve which has a synchronous sawtooth voltage applied to a second grid. In the new system, the sawtooth is replaced by a stepped waveform, with the object of reducing the effects of noise in the transmission channel. From the statistical distribution of noise amplitude it is possible to determine, for given channel width, pulse shape and number of steps, the fraction of noise which will appear in the output. The method greatly reduces crosstalk in multichannel systems.

621.376.56 **3030**

Conjugate Pulse Modulation with Linear Detection.—J. A. Ville. (*Onde élect.*, April 1954, Vol. 34, No. 325, pp. 372–375.) An analysis is made of pulse-code systems using equispaced pulses with on-off modulation. The pulse groups are decoded by simple filtering. A determination is made of the best law of coding to be used at the transmitter in conjunction with a receiving filter of known characteristics.

621.39.001.11 **3031**

Symposium on Statistical Methods in Communication Engineering.—(*Trans. Inst. Radio Engrs*, March 1954, No. PGIT-3, pp. 1–159.) The text is given of the following papers presented at a symposium at Berkeley, California, in August 1953:

Passage of Stationary Processes through Linear and Nonlinear Devices (pp. 4–25).—A. J. F. Siegert.

Statistical Theory of Signal Detection (pp. 26–51).—D. Middleton.

Detectability of Random Signals in the Presence of Noise (pp. 52–62).—R. C. Davis.

The Response of Linear Systems to Non-Gaussian Noise (pp. 63–67).—B. Gold & G. O. Young.

Estimation of Signal Parameters in the Presence of Noise (pp. 68–89).—D. Slepian.

The Use of the Method of Maximum Likelihood in Estimating Continuous-Modulated Intelligence which has been Corrupted by Noise (pp. 90–105).—D. C. Youla.

Detection of Modulated Noise-Like Signals (pp. 106–122).—R. Deutsch.

Statistically Almost Optimum Nonlinear Network Design (abstract only) (p. 123).—O. J. M. Smith.

Simple Games of Strategy occurring in Communication through Natural Languages (pp. 124–137).—B. Mandelbrot.

Application of Linear Graphs to Communication Problems (abstract only) (p. 138).—A. E. Laemmel.

Minimum-Cost Encoding of Information (pp. 139–149).—N. M. Blachman.

Generalized Servomechanism Evaluation (abstract only) (p. 150).—W. P. Caywood, Jr, R. C. Lyman & W. M. Kaufman.

Optimum Pulse-Time Determination (pp. 151–159).—A. J. Mallinckrodt & T. E. Sollenberger.

621.39.001.11 **3032**

Information Theory and Knowledge.—D. K. C. MacDonald. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, pp. 619–622.) "Distinction between data transmission from one person (or point) to another and the inception of new knowledge is analyzed in relation to information theory."

621.39.001.11 **3033**

Negentropy and Information in Telecommunications, Writing, and Reading.—L. Brillouin. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, pp. 595–599.) The Shannon formula for the capacity of a channel with noise is derived from the negentropy principle of information (794 of March) by thermodynamic considerations. The problem of writing and reading is examined; the source of light needed for reading provides the negentropy which is changed into information by the reader. The negentropy connected with organization is also discussed.

621.395.44 **3034**

The Philips Short-Haul Carrier-Telephone System STR 112.—(*Commun. News*, March/April 1954, Vol. 14, Nos. 3/4, pp. 77–128.) A series of articles describing the system, which was designed primarily to the requirements of the Dutch PTT, and which is intermediate between the voice-frequency system and the standard 4-kc/s-spaced system in present use. The STR 112 is a s.s.b. system in which the carriers are spaced at 6-kc/s intervals, and the 2-kc/s spaces between the 4-kc/s speech channels are used for signalling. Equipment for a complete channel is contained in a single sealed unit.

621.396 **3035**

High-Frequency Communications.—(*Electronic Engng*, June 1954, Vol. 26, No. 316, pp. 223–278.) Practically the whole of this issue is devoted to a review of existing practice in the field of radio communication at frequencies mainly in the range 3–30 Mc/s and to consideration of problems in this field still awaiting solution. The individual papers include:—

Commonwealth Radio Communication Services (pp. 224–231).—D. Scott.

H.F. Communication Systems (pp. 232–236.).—A. W. Cole.

A High-Power Communication Transmitter (pp. 237–241).—W. J. Morcom.

New Developments in H.F. Receivers (pp. 241–249).—F. W. J. Sainsbury.

1·5 to 30 Mc/s at Sea (pp. 250–253).—D. J. Spooner.

H.F. Airborne Communication Equipment (pp. 253–255).—G. L. Warner.

Radio Teleprinter Systems (pp. 256–259.)—D. H. C. Scholes.

Developments in Frequency-Shift Keying and Radio Teleprinter Systems (pp. 260–265).—A. G. Williamson.

A Narrow-Band Frequency-Shift Telegraph System (pp. 265–267).—R. Terlecki.

Frequency-Shift Diplex (pp. 268–271).—S. C. Heward.

Naval Low-Power M.F.-H.F. Communications (pp. 272–274).—J. R. Humphreys.

High-Power Aerial Switching (pp. 274–278).—C. Gillam.

621.396.1 **3036**

Message Error in Diversity Frequency-Shift Reception.—G. F. Montgomery. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1184–1187.) For a keyed signal, errors due to carrier fading can be specified in terms of the binary error. The binary error is calculated for several diversity selection methods, assuming narrow-band transmission, fluctuation noise interference, and a Rayleigh distribution of carrier amplitudes. The results are used to determine what reduction of transmitted carrier power can be permitted on substituting a given diversity receiving system for a single receiver.

621.396.3 : 621.376.3 **3037**

Design Considerations for Frequency-Shift-Keyed Circuits.—W. Lyons. (*RCA Rev.*, June 1954, Vol. 15, No. 2, pp. 230–237.) Analysis indicates that a considerable improvement of signal/noise ratio is obtained by using sine-wave instead of rectangular-pulse keying. Unity ratio of frequency deviation to modulation frequency gives best results. A particular keying speed giving optimum use of the frequency band is determined.

621.396.4 **3038**

Four-Channel FSK adds Radio Circuits.—C. Buff. (*Electronics*, July 1954, Vol. 27, No. 7, pp. 156–159.) A new frequency-shift keyer capable of adapting any class-C radiotelegraph transmitter to multichannel operation is described. Four channels, including keying sidebands, are accommodated in an overall bandwidth of 3·85 kc/s. Heterodyning is used, in place of the more usual frequency multiplication, to obtain carrier frequencies in the range 4–24 Mc/s.

621.396.49 : 621.397.5 **3039**

Considerations regarding the Rational Development of Television from the Economic Point of View.—Schröter. (See 3051.)

621.396.5 : 621.396.65 **3040**

Subscribers' Radio Telephone.—M. O. Felix & C. B. Wooster. (*A.T.E. J.*, April 1954, Vol. 10, No. 2, pp. 93–103.) Radio links between telephone subscribers and the exchange are required where line construction is impracticable or too costly. The design is considered of signalling and terminating units such that a radio link can be interposed in a standard line circuit without modification to the switching equipment or operating procedure. A comprehensive series of units is described, including battery-operated subscribers' equipment. Carrier suppression with frequency shift is the signalling method chosen.

621.396.65.029.63 : 621.372.55 **3041**

Use of Pulse Systems for the Simultaneous Transmission of Telephony, Telegraphy and Radio Programmes.—G. X. Potier. (*Onde élect.*, April 1954, Vol. 34, No. 325, pp. 347–355.) Modifications necessary for adapting a p.p.m. multiplex telephony system to handle programme and telegraphy signals also are discussed. The pulse repetition rate must be increased, typically by a factor of 2, to accommodate the programme signals; the multiplication may be performed either before or after modulation, but distortion considerations indicate that only the latter method is practical. Equipment operating with a carrier frequency of 1·7–2·3 kMc/s is described in which two telephony channels are conveniently replaceable by one programme channel.

621.396.721.029.51/.53 : 621.396.677 **3042**

The Problem of the Long-Wave Radio Relay.—R. Kümmich. (*Frequenz*, April & May 1954, Vol. 8, Nos. 4 & 5, pp. 112–122 & 159–166.) A detailed account is given of practical difficulties involved in establishing relay stations designed during war-time to give false d.f. bearings. The main problem was to isolate the receiver from the radiation of the associated transmitter. In designing a directive receiving aerial for a transmitter-receiver separation of 2 km a reduction factor of $1 : 10^4$ was aimed at but never achieved despite protracted investigations at two sites in North Jutland and in Holstein. This was due primarily to the variation of site error with frequency. Night effect and the effect of ground inhomogeneities, pick-up via the h.f. connecting cable and aerial movement on cardioid and figure-of-eight polar diagrams are discussed and refinements of loop and Adcock systems are described. A description is given of equipment operated, with details of its performance at 371 kc/s with bandwidth about 10 kc/s. Using an Adcock receiving system 10 km from a 1·5-kW transmitter a reduction factor of 1 : 2000 was obtained.

621.398 : 621.396.712 : 621.376.3 **3043**

A Radio-Relay Remote-Control System for FM Broadcast Stations.—T. R. Humphrey. (*Elect. Engng, N.Y.*, April 1954, Vol. 73, No. 4, pp. 327–330.) Station WVBT of the Rural Radio Network, operating on 91·5 Mc/s, is controlled from Station WVCN, 80 miles away, by means of modulation signals in the 19–24-kc/s band. Information on the power-amplifier anode voltage and current, r.f. output voltage and a.c. line-voltage is returned via a 30-kc/s modulation of the WVBT transmission. Block diagrams of the system are given. To be published also in *Trans. Amer. Inst. elect. Engrs, Communication and Electronics*, 1954.

SUBSIDIARY APPARATUS

621-526 **3044**

Analysis of Nonlinear Servos by Phase-Plane-Delta Method.—R. N. Buland. (*J. Franklin Inst.*, Jan. 1954, Vol. 257, No. 1, pp. 37–48.)

621.311.6 **3045**

Series Capacitors multiply Battery Voltage.—J. M. Reed. (*Electronics*, July 1954, Vol. 27, No. 7, pp. 182–188.) The voltage obtainable by charging capacitors in parallel and discharging them in series is increased by using a set of capacitors of graded capacitance values and charging the first by the battery only, the second by the battery in series with the first capacitor, and so on. The method has been used to provide 6·4kV, using six capacitors with a 100-V battery.

621.316.721/.722].078.3 **3046**

Voltage and Current Stabilizers for Laboratory Use.—J. Mevel. (*J. Phys. Radium*, April 1954, Vol. 15, No. 4, pp. 290–298.) A systematic exposition of the principal types of stabilizer, divided into three main classes, (*a*) direct, (*b*) feedback, and (*c*) other types. 151 references.

621.316.722.025 **3047**

A.C. Voltage Stabilizers.—W. M. Dalton. (*Electronic Engng*, July 1954, Vol. 26, No. 317, pp. 310–313.) "The operation of the output stage of the valve-operated a.c. mains stabilizer is analysed with the aid of load lines and the relative advantages of various modes of operation are briefly discussed."

621.352.7 : 537.311.33 **3048**

Semiconductors as Solid Electrolytes in Electrochemical Systems.—K. Lehovec & J. Broder. (*J. electrochem. Soc.*, April 1954, Vol. 101, No. 4, pp. 208–209.) A 'single-shot' battery and a long-life cell are described and the physicochemical principles of operation outlined. The former, an Ag-AgI-Ag_2S-S cell, gave an open-circuit voltage of $\sim 0{\cdot}2$ V at 200°C. The short-circuit current was $\sim 0{\cdot}18$ A/cm². The latter, an Ag-AgI-I(+ C) cell with an e.m.f. of $\sim 0{\cdot}7$ V at room temperature, can deliver a current of several hundred μA/cm².

TELEVISION AND PHOTOTELEGRAPHY

621.397.2 : 621.397.743 **3049**

Networks for Theater Television.—F. A. Cowan. (*J. Soc. Mot. Pict. Telev. Engrs*, April 1954, Vol. 62, No. 4, Part I, pp. 306–313.) An illustrated account of the 4-kMc/s-band radio relay system and the L1 and L3

vestigial-sideband coaxial-cable systems, with carrier frequencies of 311 kc/s and 4·139 Mc/s respectively. The systems serve 204 stations in 130 U.S. cities.

621.397.5 : 621.395.625.3 **3050**

Recording Television and Sound Signals on Magnetic Tape.—(*Electronic Engng*, July 1954, Vol. 26, No. 317, pp. 292–295.) See 2517 of August (Olson et al.).

621.397.5 : 621.396.49 **3051**

Considerations regarding the Rational Development of Television from the Economic Point of View.—F. Schröter. (*Bull. schweiz. elektrotech. Ver.*, 17th April 1954, Vol. 45, No. 8, pp. 237–243.) A two-stage plan is proposed to facilitate the development of television in countries with small populations or low purchasing power. A network of u.s.w. transmitters would be established, having bandwidths large enough for television, but operated in the first stage as sound transmitters only. A number of programmes would be available and would be sampled at picture-line frequency, a composite signal similar to the television video signal being radiated. At the receiver the desired programme would be selected by using the synchronizing signal, after passage through a delay line, as a gating pulse for a selector valve. The zero-modulation output level of the transmitter for sound would coincide with the black level for the television transmission in the second stage. The network could be used for sound transmissions during television pauses in the second stage.

621.397.5 : 621.396.712.3 **3052**

C.B.S. Television City Technical Facilities.—H. A. Chinn, R. S. O'Brien, R. B. Monroe & P. E. Fish. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1067–1091.) A detailed account is given of the C.B.S. television headquarters at Hollywood, planned eventually to occupy the whole of a 25-acre site. At the interim stage reached in 1953, four studios, two with accommodation for an audience and each with an area $> \frac{1}{4}$ acre, were completed; the design allows for 24 studio units in all, and is specially planned to facilitate expansion. A number of new techniques have been introduced.

621.397.5(083.7) **3053**

I.R.E. Standards on Television: Methods of Measurement of Aspect Ratio and Geometric Distortion, 1954.—(*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1098–1103.) Standard 54 I.R.E. 23 S1. Correction, *ibid.*, Aug. 1954, Vol. 42, No. 8, p. 1314.

621.397.5(083.75)(931) **3054**

Choosing a Television Standard.—*Wireless World*, Aug. 1954, Vol. 60, No. 8, pp. 401–402.) See 2235 of July.

621.397.6.001.4 **3055**

Synthetic-Pattern Generator for the Solution of Certain Instrumentation Problems in Television.—Webb. (See 3009.)

621.397.61 : 621.375.2.029.63 : 621.385.029.63 **3056**

A U.H.F. Transmitter employing Klystron Power Amplifiers.—W. H. Sayer. (*Elect. Engng, N.Y.*, April 1954, Vol. 73, No. 4, pp. 354–359.) Applications are discussed of the 3K20,000LK klystron in both narrow- and wide-band power amplifiers operating in the 720–890-Mc/s frequency band. The circuit efficiency of a klystron output circuit in a 5-kW television transmitter is 97·9% compared with 73% for the 4 × 150G tetrode used as modulated amplifier delivering 120 W peak. The demountable cavities allow tuning without changing the gap spacing of the drift tubes. Two other similar klystrons will cover the 470–720-Mc/s frequency band. To be published also in *Trans. Amer. Inst. elect. Engrs, Communication and Electronics*, 1954.

621.397.611.2 **3057**

Electronic Light-Trace Marker, a New Apparatus for Television Studios and Outside-Broadcast Equipment.—R. Sondermeyer. (*Funk u. Ton*, April 1954, Vol. 8, No. 4, pp. 179–186.) A portable unit has been developed for superimposing a light trace of triangular or other form on a picture during transmission. The trace can be adjusted to any position in the frame by means of a hand-operated control. A detailed description is given of the derivation of the pulse train forming the marker trace from horizontal and vertical blanking pulses.

621.397.611.2 : 778.5 **3058**

Continuous All-Electronic Scanner for 16 mm Color Motion-Picture Film.—V. Graziano & K. Schlesinger. (*J. Soc. Mot. Pict. Telev. Engrs*, April 1954, Vol. 62, No. 4, Part I, pp. 294–305; *Proc. nat. Electronics Conf., Chicago*, 1953, Vol. 9, pp. 370–381.) The Motorola flying-spot system and equipment are described. The kinescope scans the odd-numbered film frames three times and the even-numbered frames twice, thus converting the 24 frames/sec to 60 television fields/sec. A signal derived from the leading edges of the sprocket perforations is used to control the position of the scan on the tube screen and is also used for continuous correction of film shrinkage. The anastigmatic deflection yoke and the adjustable gamma control are also briefly described.

621.397.62 **3059**

Printed Circuit Television Set.—C. Bovill. (*Wireless World*, Aug. 1954, Vol. 60, No. 8, pp. 363–366.) Use of printed-circuit technique may be more useful for television than for ordinary sound receivers, because the main design features are more likely to remain stable. An illustrated description is given of an 819-line receiver of French manufacture, for single-channel operation in the 174–185-Mc/s band, in which the wiring, coils and smaller capacitors are printed.

621.397.62 **3060**

Combined 625-819 Line Receiver.—R. Gondry. (*Télévision*, March–May, 1954, Nos. 42 & 43, pp. 85–91 & 122–127.) A multichannel receiver designed particularly for the transmissions from Baden-Baden, Strasbourg and Paris in the upper v.h.f. band. A detailed description of the receiver construction is given with diagrams of circuit arrangement, chassis dimensions and coil data. Alignment procedure and switching arrangements are described. Operating data are given and characteristic oscillograms are shown.

621.397.62 : 621.386.842 **3061**

A Solid-State Image Intensifier.—R. K. Orthuber & L. R. Ullery. (*J. opt. Soc. Amer.*, April 1954, Vol. 44, No. 4, pp. 297–299.) A method of image intensification which avoids the need for an evacuated envelope uses a layer of a photoconductor such as CdS in contact with a layer of electroluminescent phosphor. In an example, the brightness gain is of the order of two; this is in satisfactory agreement with the theoretical value. The construction of the image intensifier is described and its application to the intensification of projected television pictures is mentioned.

621.397.62 : 621.396.82 **3062**

Spurious Radiation from TV Receivers.—K. A. Chittick. (*Trans. Inst. Radio Engrs*, April 1954, No. PGBTR-6, pp. 71–77.) Recent investigations of radio interference and television-receiver oscillation are reported. Standards proposed for broadcast-band inter-

ference limit the field generated by the television-receiver sweep-oscillator to 100 μV/m at 15 ft and the voltage on a power line from the same source to 100 μV between line and earth. The field strength required at the television aerial to give a reasonable picture signal is discussed. Possible interference to different services due to local-oscillator radiation throughout the television bands is considered; the present standard tolerance for v.h.f., particularly channels 4 and 7, should be reduced by half to provide a greater safety factor for the omnidirectional-range services and amateur stations; the limit of 500 μV/m for u.h.f. seems satisfactory.

621.397.62.001.4 : 621.397.8 **3063**

Factors affecting the Correlation of TV Picture Quality between Field and Laboratory Signals.—Amos & Quirk. (See 3010.)

621.397.621 : 621.318.4 **3064**

High-Efficiency, Low-Copper Sweep Yokes with Balanced Transient Response.—C. E. Torsch. (*Trans. Inst. Radio Engrs*, April 1954, No. PGBTR-6, pp. 17–32.) An improved design of deflection-coil assembly is described. It gives a sweep angle of 70° and is no larger than an earlier 50°-sweep unit. It uses the shorter coils for the horizontal sweep, one of this pair of coils being wound in reverse; if the pair is connected in parallel no balancing capacitor is required. Coils have interlocking flared ends, a design permitting reduction of the length of the assembly. Advantages of the coil reversal are discussed and improved techniques of winding and insulation are noted. See also 2916 of 1950.

621.397.621 : 621.318.4 : 535.623 **3065**

Extension of the Balanced-Transient Response Principle to Color TV Yokes.—C. E. Torsch. (*Trans. Inst. Radio Engrs*, April 1954, No. PGBTR-6, pp. 33–35.) The principles of reverse winding and parallel connection of the coil halves (3064 above) are applied to vertical-sweep windings. Connections are arranged so that the high-potential turns of one pair of coils are adjacent to the low-potential turns of the quadrature coils.

621.397.7 : 621.375.2.029.62 **3066**

Line Amplifiers for Community Television Systems.—K. A. Simons, D. Kirk & H. J. Arbeiter. (*Elect. Engng, N.Y.*, April 1954, Vol. 73, No. 4, pp. 337–342.) Discussion of the relative technical and economic merits of (*a*) single-channel, (*b*) cascade, and (*c*) distributed broad-band amplifiers in a three-channel and a seven-channel v.h.f. television system. Results show that type (*a*) is to be preferred in large systems, type (*b*) in small systems with short cable runs and few repeaters. To be published also in *Trans. Amer. Inst. elect. Engrs, Communication and Electronics*, 1954.

621.397.813 **3067**

Method of Equalizing Television Transmissions by Deliberate Introduction of Echoes.—J. Müller. (*Fernmeldetech. Z.*, April 1954, Vol. 7, No. 4, pp. 199–204.) A circuit is described in which delay lines are used to introduce short-delay echoes so as to produce time equalization of the transient response up to 0·5 μs. The improvements effected are illustrated by oscillograms.

621.397.82 **3068**

Television Receiver Interference Industry Record to Date.—L. M. Clement. (*Trans. Inst. Radio Engrs*, April 1954, No. PGBTR-6, pp. 50–58.) Investigations made by the U.S. Radio Manufacturers Association in conjunction with other bodies are reported. Interference from police transmitters in television receivers using the standard 41·25-Mc/s i.f. is noted. A survey has been made of the progress of this standardization. Information based on answers to questionnaires is presented, relating to the use made of field-test facilities and to measurements of oscillator radiation from television and f.m. receivers.

VALVES AND THERMIONICS

621.314.63 : 546.289 **3069**

Capacitance Measurements on Alloyed Germanium-Indium Rectifiers.—H. L. Rath. (*Naturwissenschaften*, April 1954, Vol. 41, No. 7, pp. 161–162.) Independent determinations of the impurity concentration based on (*a*) conductivity and (*b*) capacitance give results in agreement with one another.

621.314.632 : 546.289 **3070**

Observations on a Form of Breakdown in Germanium Diodes.—A. Lempicki & C. Wood. (*Proc. phys. Soc.*, 1st April 1954, Vol. 67, No. 412B, pp. 328–337.) The I/V characteristic of the Ge diode is shown to depend on the wavetorm applied. The critical barrier temperature at which the breakdown observed by Billig (437 of 1953) occurs and the barrier radius are obtained by postulating a simple model for the contact. The possibility that the breakdown is due to thermal instability is discussed.

621.314.7 **3071**

New Advances in the Junction Transistor.—E. W. Herold. (*Brit. J. appl. Phys.*, April 1954, Vol. 5, No. 4, pp. 115–126.) A survey of recent work in the U.S.A. on alloy junction transistors, their geometry, characteristics and applications. See also Mueller & Pankove (1955 of June).

621.314.7 : 546.28 **3072**

Silicon Transistor.—W. A. Adcock, M. E. Jones, J. W. Thornhill & E. D. Jackson. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, p. 1192.) Measurements are reported on *n-p-n* transistors made from single crystals of Si, with base layers about 0·0005 in. thick. The results confirm the view that Si transistors can handle more power than similar Ge units.

621.314.7 : 621.357 **3073**

Electrolytic Analog Transistor.—H. Letaw, Jr, & J. Bardeen. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, pp. 600–606.) An operating model of a junction transistor is described which substitutes the reduced and oxidized forms of ions in solution for electrons and holes in a semiconductor. The emitter and collector are circular platinum electrodes of diameter 0·5 in., with adjustable spacing. A mercury pool in contact with mercurous chloride and chloride ion makes a satisfactory base electrode. The cell is of lucite. Because the mobility of the ions is much lower than that of electrons and holes, flow phenomena can be studied more readily. This electrolytic transistor may also prove useful as a constant-current device.

621.314.7 : 621.372.5 **3074**

Equivalent Circuits of Transistors, and their Physical Basis.—J. Malsch. (*Arch. elekt. Übertragung*, April 1954, Vol. 8, No. 4, pp. 179–189.) The form of equivalent circuit originally introduced to represent the point-contact transistor was found to require modification in the light of increased knowledge of the physics of transistors and the development of junction types. An equivalent circuit is presented which is based on diffusion-theory analysis and gives a satisfactory representation of the transistor with frequency-independent elements up to relatively high frequencies.

621.38.002.2 : 535.336.2 **3075**

Mass Spectrometry in the Electronics Industry.—T. G. Polanyi. (*Sylvania Technologist*, April 1954, Vol. 7, No. 2, pp. 51–58, 61.) Applications in research, developmeat and production are described.

621.383 : 546.28 **3076**

A New Silicon p-n Junction Photocell for Converting Solar Radiation into Electrical Power.—D. M. Chapin, C. S. Fuller & G. L. Pearson. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, pp. 676–677.) Photons of energy 1·02 eV or more ($\lambda \leqslant 1{\cdot}2\,\mu$) are able to produce electron-hole pairs in Si; in the presence of a *p-n* barrier these pairs are separated and do work in an external circuit. Calculation indicates that the upper limit of efficiency of such a cell is about 22%; in practical devices the efficiency is reduced by reflection of radiation at the Si surface, by recombination of electrons and holes before reaching the barrier, and by losses due to surface-layer and contact resistance. See also 2779 of September.

621.383.27 **3077**

Fatigue in an Electron-Multiplier Photocell.—F. Lenouvel & J. Daguillon. (*J. Phys. Radium*, April 1954, Vol. 15, No. 4, pp. 287–289.) The fatigue observed in a photomultiplier passing an anode current of 4×10^{-7} A is due to the resistance of the semiconductor film covering the electrode in the final multiplier stage. This resistance is about 200 MΩ at room temperature. The electrodes of the preceding stages do not contribute appreciably to the fatigue until the anode current reaches higher values.

621.385 : 538.691 **3078**

Electron Trajectories in Strip Beams Constrained by a Magnetic Field.—J. D. Lawson. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1147–1151.) Analysis is presented for idealized cases. Different types of solution are obtained according as the electron gun is outside or inside the magnetic field; in the former case the nature of the flow depends also on the current density relative to a critical value. The beam width varies periodically along the beam in all cases.

621.385 : 621.318.57 **3079**

Development of Trochotrons.—J. Björkman & L. Lindberg. (*Kungl. tek. Högsk. Handl., Stockholm*, 1954, No. 80, 131 pp.) A comprehensive account of the design, construction and applications of magnetron-type switching valves previously described [1205 of 1948 (Alfvén & Romanus), etc.].

621.385 : 621.396.822 **3080**

The Noise of Valves.—C. S. Bull. (*Brit. J. appl. Phys.*, April 1954, Vol. 5, No. 4, pp. 127–132.) Theory developed in 909 of March and back references is restated and extended to include the effects of screen grids and secondary-electron multiplication.

621.385.004.15 **3081**

Electron-Tube Life and Reliability: Part 1.—M. A. Acheson. (*Sylvania Technologist*, April 1954, Vol. 7, No. 2, pp. 45–50.) "The reliability of an electron tube may be described in terms of its failure rate for a given type of failure under specified conditions of operation including environmental, mechanical, and electrical factors. When failure rates are determined by proper analysis of obtainable data, the degree of reliability that may be expected can be predicted by use of statistical procedures. In simple cases the binomial formula may be used. When larger quantities of tubes are involved, the simpler Poisson formula may be used. Applications are described in elementary terms, and several examples are given."

621.385.029.6 **3082**

Stored Energy and Power Flow in Electron Beams.—L. R. Walker. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, pp. 615–618.) Analysis of the interaction between a weak travelling wave and a homogeneous beam indicates that the density of a.c. energy and the a.c. power flow in the beam depend on the manner in which the travelling wave is established.

621.385.029.6 **3083**

Experimental Investigation of the Operation of the Reflection Space of a Reflex Klystron.—M. de Bennetot. (*Ann. Radioélect.*, April 1954, Vol. 9, No. 36, pp. 150–162.) Continuation of work previously reported (3159 of 1953). The length of the drift space is determined, and the influence of the angle of incidence of the electrons in the drift space and of the reflector curvature is assessed, with and without space charge. The influence of higher-order terms in the expressions for the transit angle and current are evaluated. Measurements on a Type-KR370 valve are reported. It is concluded that the bunching efficiency cannot be found simply by calculation, but can be determined approximately by measurements.

621.385.029.6 **3084**

Some Recently Obtained Results on Valves for Microwave Frequencies.—R. R. Warnecke. (*Ann. Radioélect.*, April 1954, Vol. 9, No. 36, pp. 107–136.) A review with special attention to the magnetron-type travelling-wave amplifier and the carcinotron oscillator. 74 references. For a similar review in English see 901 of March (Warnecke & Guénard).

621.385.029.6 **3085**

Fundamental Phenomena in Travelling-Wave Valves.—R. Warnecke, P. Guénard & O. Doehler. (*Onde élect.*, April 1954, Vol. 34, No. 325, pp. 323–338.) A résumé is given of theory covering various types of travelling-wave valves, including both amplifiers and oscillators. See also 901 of March (Warnecke & Guénard).

621.385.029.6 **3086**

Traveling-Wave Tubes.—R. G. E. Hutter, S. Cutler & H. Greenberg. (*Radio & Telev. News, Radio-Electronic Engng Section*, April 1954, Vol. 51, No. 4, pp. 23–25, 71.) The main features and principles of operation of various types are outlined.

621.385.029.6 : 621.372.2 **3087**

Investigation of Lines with Periodic Bar Structure for U.H.F. Valves.—A. Leblond & G. Mourier. (*Ann. Radioélect.*, April 1954, Vol. 9, No. 36, pp. 180–192.) General theory, based on that for multiconductor lines, is given for delay lines constituted by arrangements of bars; such lines have properties intermediate between those of the helix and those of the multicavity circuit. The characteristic impedance introduced by Fletcher (3275 of 1952) is used in conjunction with the transverse field distribution to calculate the energy stored in the vicinity of the bars. The circuit of the interdigital magnetron is analysed in detail.

621.385.029.6 : 621.373.423 **3088**

The Frequency Spectrum of the Strapped Magnetron.—I. Palócz. (*Acta tech. Acad. Sci. hungaricae*, 1954, Vol. 9, Nos. 1/2, pp. 135–147. In English.) The frequency spectrum of the unstrapped magnetron and of a double-ring strapped type are deduced from considerations of the respective equivalent circuits. A simple formula is derived for the frequency separation of the N/2, or II mode from the adjacent (N/2 − 1) mode in the strapped magnetron.

621.385.029.63/.64 **3089**

Bifilar Helix for Backward-Wave Oscillators.—Ping King Tien. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1137–1143.) By applying a potential difference between the wires of the bifilar helix, a periodic beam-focusing field is provided. Measurements on an experimental valve are reported; on varying the potential difference from 0 to 2·3 kV, the collector current passed through a maximum at 480 V, approximately the value of the beam voltage. Oscillations at frequencies between 3 and 3·5 kMc/s were obtained.

621.385.029.63 **3090**

A Developmental Medium-Power Traveling-Wave Tube for Relay Service in the 2 000-Megacycle Region.—W. W. Siekanowicz. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1091–1097; *Proc. nat. Electronics Conf., Chicago*, 1953, Vol. 9, pp. 601–608.) The valve described has a power output of 2·5 W or more, a gain of 20–30 db and a small-signal bandwidth of 500 Mc/s. The operating voltage required is < 700 V. Coaxial input and output connections are provided to the helix, which has a length of about 3 in. The design includes a conventional U-type permanent magnet, weighing 10–15 lb, for beam focusing.

621.385.029.63 : 621.397.61 : 621.375.2.029.63 **3091**

A U.H.F. Transmitter employing Klystron Power Amplifiers.—Sayer. (See 3056.)

621.385.029.64 **3092**

Nonreciprocal Loss in Traveling-Wave Tubes using Ferrite Attenuators.—J. S. Cook, R. Kompfner & H. Suhl. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1188–1189.) Unwanted oscillations in travelling-wave valves with helical lines can be prevented by surrounding the helix with a ferrite cylinder with a circumferential component of magnetization, which introduces small loss in the direction of electron flow and large uniformly distributed loss in the backward direction.

621.385.029.64.001.57 **3093**

A Mechanical Traveling-Wave Oscillator.—C. C. Cutler. (*Bell Lab. Rec.*, April 1954, Vol. 32, No. 4, pp. 134–138.) A simple magneto-mechanical model is described for demonstrating the coupling between waves and electron streams such as occurs in travelling-wave valves. The analogies discussed reveal wave-interaction characteristics which may have applications in l.f. transmission-line circuits.

621.385.032.216 **3094**

Transient Phenomenon in the Oxide Cathode Layer.—T. Shindo. (*J. phys. Soc. Japan*, Jan./Feb. 1954, Vol. 9, No. 1, pp. 38–43.) The theory previously given (591 of February) is extended to clarify the transient phenomenon in the building-up of the space charge near the surface of the oxide layer.

621.385.2 : 537.525.92 **3095**

Approximate Solutions of the Space-Charge Problem for Some Unusual Electrode Geometries.—H. F. Ivey. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, p. 543.) Correction to paper abstracted in 1973 of June.

621.385.2 : 621.396.621 **3096**

Vacuum-Tube Detector and Converter for Microwaves using Large Electron Transit Angles.—A. B. Bronwell, T. C. Wang, I. C. Nitz, J. May & H. Wachowski. (*Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, pp. 1117–1123.) An analysis is made of the motion of electrons in space-charge-limited diodes, for very large transit angles; the effect of the Maxwell-Boltzmann distribution of emission velocities is taken into account. The net effect of the microwave field is to increase the rate at which electrons are removed from the space-charge region; this explains the observed increase of anode current and the detection and conversion effects.

621.385.3 : 621.375.232.4.029.62 : 621.396.822 **3097**

Study of Noise Reduction by Feedback in Ultra-high Frequency Amplifiers.—Glenn. (See 2899.)

621.385.4-71 **3098**

Heat Transfer from Electron Tubes at High Altitudes and High Ambient Temperatures.—B. O. Buckland. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 698–703. Discussion, p. 703.) Results are reported of tests on a Type-6AQ5 beam power tetrode at simulated high altitudes.

621.385.832 **3099**

Focusing of an Electron Beam by Periodic Fields.—A. M. Clogston & H. Heffner. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, pp. 436–447.) Analysis is presented for the four cases of periodic fields of the axially symmetric and four-pole types with focusing either by electric or by magnetic fields. Under certain stated conditions parallel flow will be obtained in the beam. Actual trajectories as plotted by the analogue computer are shown and charts and equations assembled to aid in the design of practical focusing systems.

621.385.832 **3100**

A Monoscope Tube for Computer and other Applications.—J. Hartmann. (*Elect. Engng, N.Y.*, March 1954, Vol. 73, No. 3, pp. 208–212.) Description of the Type-K1043 monoscope tube and associated circuits. The tube is designed to resolve 30 lines of a symbol, using a second-anode supply of 1 kV and single-ended deflection.

621.387 : 621.316.722 **3101**

Impedance-Frequency Variations of Glow-Discharge Voltage-Regulator Tubes.—F. A. Benson & G. Mayo. (*Electronic Engng*, May 1954, Vol. 26, No. 315, pp. 206–210.) Measurements were made over the range 20 c/s to 10 kc/s of the impedance of tubes of Types 85A1, 85A2, 7475 and S130. The tube impedance includes both resistive and reactive components, the reactance being inductive. The impedance and resistance of all tubes increase approximately by factors of 4 and 2 respectively over the range. The inductance shows a pronounced maximum at about 100 c/s.

MISCELLANEOUS

621.3(083.7) **3102**

I.R.E. Standards on Graphical Symbols for Electrical Diagrams, 1954.—(*Proc. Inst. Radio Engrs*, June 1954, Vol. 42, No. 6, pp. 965–1020.) Standard 54 I.R.E. 21S1.

621.396 : 061.3 **3103**

Convention Record of the I.R.E.—This publication, comprising ten separate parts, contains the full text or abstracts of papers presented at the I.R.E. National Convention, New York, March 22–25, 1954.

621.396 **3104**

Advances in Electronics, Vol. IV. [Book Review]—L. Marton (Ed.). Publishers: Academic Press, New York, 1952, 344 pp., $8.50. (*Electronic Engng*, May 1954, Vol. 26, No. 315, pp. 220–221.) Vol. III: 2674 of 1952.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.2 **3105**

Variational Principles for the Acoustic Field.—E. Gerjuoy & D. S. Saxon. (*Phys. Rev.*, 15th June 1954, Vol. 94, No. 6, pp. 1445–1458.) "Variational principles are presented for the scattering amplitude in the general acoustic scattering problem, and, for spherically symmetric scatterers, for the phase shifts. Integral equations for the acoustic field are also given and the properties of the scattering matrix are developed. The entire formulation remains valid in the presence of discontinuities of density and/or velocity in the medium."

534.321.9 **3106**

Proposal for Standardization of the Expression for the Power delivered by an Ultrasonic Source.—M. Degrois. (*Ann. Télécommun.*, April 1954, Vol. 9, No. 4, pp. 99–102.) The advantages of defining ultrasonic energy in terms, not of the total surface area of the radiator, but of the active area, are pointed out.

534.41 **3107**

Applications of Sound Spectrography in Acoustics Research.—W. Kallenbach. (*Akust. Beihefte*, 1954, No. 1, pp. 403–407.) Equipment based on the same principle as that of Koenig et al. (3517 of 1946) is described, and spectrograms are shown illustrating the time and frequency distributions of energy in sounds characteristic of bells, trains, motor-car engines and ball-bearings.

534.6 : 534.321.9 **3108**

Pulse Apparatus for Measuring Absorption and Phase Velocity of Ultrasonic Waves in Liquids: Measurements on Liquid Naphthalene.—G. Busch & W. Maier. (*Z. Phys.*, 8th May 1954, Vol. 137, No. 4, pp. 494–502.) The accuracy obtainable using the interferometer apparatus described is within 0·1% for velocity determinations and within 1% for absorption-coefficient determinations. Attenuation is determined from a compensating adjustment of a calibrated attenuator, velocity from the observed wavelength and the known frequency. An oscilloscope is used as indicator. A frequency of 12 Mc/s was used in the experimental determination.

534.614 : 534.321.9 **3109**

A Combined Time- and Phase-Modulation Method for Measurement of Sound Velocities using Commercial Ultrasonic-Pulse Equipment.—H. Schmauch & W. Bentz. (*Z. angew. Phys.*, April 1954, Vol. 6, No. 4, pp. 168–171.) The calibrated variable-length liquid delay line is briefly described and an account is given of its application in an interference method of determining the velocity of sound.

534.75 **3110**

The Threshold of Audibility for Sounds with Frequency Spectrum of Various Widths.—G. Gässler. (*Akust. Beihefte*, 1954, No. 1, pp. 408–414.) When the sound components occupy a bandwidth less than a critical value called the coupling bandwidth, the sound-pressure level required for a complex sound to be just audible decreases as the number of components is increased. A complex sound will be just audible if within any coupling bandwidth the acoustic power is that which a single sine wave must have in order to be just perceptible.

534.75 **3111**

The Masking of Narrow-Band Noise by Sine Waves.—E. Zwicker. (*Akust. Beihefte*, 1954, No. 1, pp. 415–420.) Two sine waves with various frequency differences were superposed on white noise of the same frequency range. Regions of constant and variable masking were observed, independent of sound-pressure level, the critical frequency difference being about 90 c/s up to a mean frequency of 500 c/s and, above that, about 20% of the mean frequency.

534.75 **3112**

The Problem of the Accuracy of Hearing of Persons with Impaired and Normal Hearing in the Presence of Traffic Noise.—F. J. Meister. (*Akust. Beihefte*, 1954, No. 1, pp. 421–427.)

534.78 : 621.395.625.3 **3113**

A Speech-Waveform Correlator with Magnetic-Tape Delay and Electronic Multiplication.—J. N. Holmes & J. M. C. Dukes. (*Proc. Instn elect. Engrs*, Part III, July 1954, Vol. 101, No. 72, pp. 225–237.) An instrument designed to compute the auto- and cross-correlation functions of speech sounds having a duration < 10 sec.

534.8 **3114**

Normal-Frequency Statistics and Excitation Statistics [of normal modes] **in Rooms.**—M. Schröder. (*Akust. Beihefte*, 1954, No. 1, pp. 456–468.) Measurements were made on e.m. cavity resonators; the results are interpreted for acoustic waves. In general the distribution both for normal-frequency spacing and for excitation of normal modes is a random one for fairly large rooms.

621.395.61/.62 **3115**

Uniform Electrical-Equivalent-Circuit Diagrams for Electroacoustic Transducers.—R. Feldtkeller & W. Nonnenmacher. (*Arch. elekt. Übertragung*, May 1954, Vol. 8, No. 5, pp. 191–196.) Equivalent circuits based on the analogy between force and voltage are presented. Gyrators are included in the circuits corresponding to electrodynamic and magnetic transducers to indicate that these do not obey the law of inversion.

621.395.61 **3116**

A New Microphone with High Directivity.—K. Tamm & G. Kurtze. (*Akust. Beihefte*, 1954, No. 1, pp. 469–470.) See 1982 of July (Kurtze).

621.395.623.7 **3117**

Mechanical Transients in the Electrodynamic Loudspeaker.—N. Mayer. (*Funk u. Ton*, May 1954, Vol. 8, No. 5, pp. 239–243.) An equivalent-circuit analysis shows how the time constant of transient vibrations occurring on sudden excitation of a moving-coil loudspeaker can be calculated from the electrical impedance of the circuit. Calculated and experimentally determined values for damping factor are compared. A formula giving the value of source resistance for critical damping is noted.

621.395.625.3 **3118**

Methods of Measuring Surface Induction of Magnetic Tape.—J. D. Bick. (*J. Soc. Mot. Pict. Telev. Engrs*, May 1954, Vol. 62, No. 5, p. 383.) Correction to paper abstracted in 2552 of 1953.

621.395.625.3 **3119**

Bibliography of Magnetic Recording 1900–1953.—A. Jorysz. (*Tele-Tech*, July 1954, Vol. 13, No. 7, pp. 54–56..112.)

AERIALS AND TRANSMISSION LINES

621.372.2 **3120**

Theory of Composite Guides: Stratified Guides for Surface Waves.—A. E. Karbowiak. (*Proc. Instn elect. Engrs*, Part III, July 1954, Vol. 101, No. 72, pp. 238–242.) The propagation of the plane surface wave over a guide consisting of two layers of different media covering a third semi-infinite medium is investigated and expressions are derived for the decay coefficient and the surface impedance. Four special cases are considered: (*a*) the third medium a perfect conductor, (*b*) a conductor coated with several layers of different dielectrics, (*c*) electroplated surfaces, and (*d*) single-wire transmission lines.

621.372.2 **3121**

Loss Measurements of Surface-Wave Transmission Lines.—E. H. Scheibe, B. G. King & D. L. Van Zeeland. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 790–797.) Several methods of measurement are discussed; one involving the Q of a resonator formed by short-circuiting both ends of a length of line was found best. Measurements were made on ten dielectric-coated wires, at 9·365 kMc/s; the losses ranged from about 3 db/100 ft for thin coatings to about 11·5 db/100 ft for thick coatings. Results are tabulated and compared with values derived from Goubau's analysis.

621.372.2 **3122**

Surface Waves Propagated along a Single Cylindrical Conductor.—M. D. Karasev & V. A. Apanasenko. (*Zh. tekh. Fiz.*, April 1954, Vol. 24, No. 4, pp. 662–666.) Experimental confirmation of Goubau's results (812 of 1951) is reported. The attenuation of the line with launching horns was < 3 db at 10^{10} c/s using copper conductors of radius 0·024–0·125 cm and length 150–285 cm. The horn radius could be reduced to 5 cm with negligible change of energy losses. Results of measurements of the magnetic field at radial distances up to $\sim 1{\cdot}25$ cm from the axis of the conductor are shown graphically. Results of similar measurements on an enamel-covered copper conductor are also shown.

621.372.2 : 621.315.212 **3123**

Coaxial Line with Helical Inner Conductor.—W. Sichak. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1315–1319.) Analysis is presented for the general case. The expression $(2\pi Na)\ (2\pi a/\lambda)$ is found to represent a significant parameter, N being the number of turns per unit length and a the helix radius. The variation of propagation velocity and helix impedance with line dimensions is examined separately for cases where this parameter is (*a*) smaller than, and (*b*) greater than unity. The influence of dielectrics inside and outside the helix is discussed. From consideration of Q values it is found that for frequencies below about 500 Mc/s the volume of a line of this type is considerably less than that of a conventional coaxial-line resonator.

621.372.2 : 621.315.212 **3124**

Transmission Formulas and Charts for Laminated Coaxial Cables.—R. A. King & S. P. Morgan. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1250–1258.) Metal losses in laminated cables [2908 of 1951 (Clogston)] are compared with the losses in conventional coaxial cable and the optimum proportions for the laminated cable are discussed. Dielectric losses and the effects of nonuniformities are also considered. Formulae and charts for the attenuation and bandwidth characteristics are presented and their use is illustrated by numerical examples.

621.372.2 : 621.315.212.011 **3125**

Secondary Parameters of a Coaxial Pair at High Frequencies.—R. Cazenave. (*Câbles & Transm.*, April 1954, Vol. 8, No. 2, pp. 159–171.) Calculation of attenuation, phase shift, phase velocity and characteristic impedance, given permittivity and loss angle of the dielectric, is simplified at frequencies above 1 Mc/s by using asymptotic expressions for resistance and inductance per unit length (1194 of 1952). Exact representation of the characteristic impedance by the impedance characteristic of an equivalent RC network is not possible at the higher frequencies.

621.372.51 : 621.315.212 **3126**

Conical Joint.—É. G. Solov'ev. (*Radiotekhnika, Moscow*, May/June 1954, Vol. 9, No. 3, pp. 76–78.) The two coaxial connectors considered are (*a*) a conical conductor inside a cylindrical conductor, and (*b*) coaxial cylindrical conductors with conical internal surface of external conductor. The wave impedance, defined as the ratio of the p.d. between the conductors to the current flowing in one of them, is calculated. The real part of the expression equals in the first approximation the characteristic impedance of a coaxial line having the same dimensions as the conical junction at the given section, the reactive component depends on the geometry, the medium, and the wavelength, increasing with increasing wavelength.

621.372.8 3127

Time Constant of a Cylindrical Electric Guide.—P. Poincelot. (*C. R. Acad. Sci., Paris*, 21st June 1954, Vol. 238, No. 25, pp. 2394–2395.) Analysis is given for a guide with a perfectly conducting metal wall, using theory developed previously (2179 of 1952). A calculation for the case of a guide of diameter 76·5 mm and length 3 km, excited by a klystron on a wavelength of 8·6 mm and operating in the H_{01} mode, gives a time > 40 mμs for the signal on arrival to grow from 0·1 to 0·9 of its steady-state value.

621.372.8 3128

Some Results of the General Theory of Waveguides with Diaphragms.—G. N. Rapoport. (*Radiotekhnika, Moscow*, May/June 1954, Vol. 9, No. 3, pp. 78–80.) Formulae are given for the numerical evaluation of the equivalent susceptance of a single plane diaphragm with an arbitrarily shaped aperture, for the distribution of the field and dispersion of normal waves in a waveguide with diaphragms, and for the constants of the equivalent quadripole.

621.372.8 : [537.562 + 621.318.134 3129

Topics in Guided Wave Propagation through Gyromagnetic Media: Part 2 — Transverse Magnetization and the Non-Reciprocal Helix.—H. Suhl & L. R. Walker. (*Bell Syst. tech. J.*, July 1954, Vol. 33, No. 4, pp. 939–986.) "Propagation through a gyromagnetic medium in a direction normal to a uniform magnetizing field is considered. Geometrical arrangements which make this propagation non-reciprocal are described. A few illustrative examples are discussed briefly. The non-reciprocal helix, of importance in traveling wave tube work, is treated at length." Part 1: 2563 of September.

621.372.8.002.2 3130

Light-Weight Waveguides.—P. A. Akin. (*Elect. Mfg.*, March 1954, Vol. 53, No. 3, pp. 112–117.) Report of U.S. Air Force investigations into the production of lightweight waveguides. Two methods were developed, one using magnesium and the other stainless-steel strip.

621.372.8.011.2 3131

Characteristic Impedance of Rectangular Waveguides with H_{10} Waves.—H. Meinke & H. W. Urbarz. (*Fernmeldetech. Z.*, May 1954, Vol. 7, No. 5, pp. 247–248.) The definition of the characteristic impedance is discussed.

621.396.67 3132

Determination of a Direction of Maximum Gain and Stationary Polarization for the Monochromatic Electromagnetic Radiation at Infinity of an Arbitrary [aerial] **System.**—M. Bouix. (*C. R. Acad. Sci., Paris*, 5th July 1954, Vol. 239, No. 1, pp. 35–37.) A formula derived by Goudet (340 of 1948) is used to determine the condition for the gain to be maximum (i.e. the modulus of the Poynting vector to be maximum) in a given direction. There is no essential incompatibility between this condition and that for the polarization to be stationary in the same direction.

621.396.67 : 538.566 3133

Electromagnetic Field of a Dipole Source above a Grounded Dielectric Slab.—Lo. (See 3201.)

621.396.677 : 621.318.134 3134

Ferrite Rod Aerials.—W. A. Everden. (*Wireless World*, Sept. 1954, Vol. 60, No. 9, pp. 440–444.) Underlying principles are discussed and design formulae are presented for aerials based on ferroxcube rods in grade B2, having an initial permeability of about 200, resistivity $10^5\Omega$.cm and loss factor 90×10^{-6} at 0·5 Mc/s. The influence of coil position and type of winding is investigated.

621.396.677.3 + 621.396.677.71 3135

On the Design of Arrays.—J. N. Hines, V. H. Rumsey & T. E. Tice. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1262–1267.) Exact design theory for aerial arrays is given which takes account of the modification of the radiation pattern of individual elements due to the presence of the other elements of the array. Results obtained for a travelling-wave slot aerial are compared with those obtained previously by the approximate method [334 of February (Hines et al.)]. Use of the exact method is particularly important when designing arrays to give very weak side lobes.

621.396.677.3 3136

The Principle and the Design of the Yagi-Uda Antenna: Part 2.—S. Uda & Y. Mushiake. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, June 1953, Vol. 5, No. 1, pp. 51–75.) Application of the theory given in part 1 (2314 of August) to the design of the fed element, the reflector and the director elements, illustrated by numerical examples. Design charts, tables, formulae and a nomogram are given for two- and three-element aerials.

621.396.677.3 : 523.7 : 621.396.822.029.64 3137

Multiple-Element Interferometer for Locating Sources of Solar Noise at 4 000 Mc/s.—Tanaka & Kakinuma. (See 3204.)

621.396.677.7 3138

Radiation Properties of the Open End of a Rectangular Waveguide when the End Plane is inclined to the Guide Axis.—G. S. Sanyal. (*Indian J. Phys.*, Sept. 1953, Vol. 27, No. 9, pp. 465–475.) Radiation patterns were obtained experimentally for waveguides of internal dimensions 0·9 in. × 0·4 in., with the plane of the open end perpendicular to the H plane but inclined at various angles to the axis; excitation wavelengths of 3·2–3·5 cm were used. The best compromise as between small width of major lobe and low intensity of minor lobes was obtained for an inclination of about 50°. Calculations based on diffraction theory give results in fair agreement with those obtained experimentally. Measurements of the v.s.w.r. indicate that matching between the open end and free space is better when the inclination is greater.

621.396.677.832 3139

Directivity Diagrams of Corner-Reflector Slot Aerials.—G. N. Kocherzhevski. (*Radiotekhnika, Moscow*, May/June 1954, Vol. 9, No. 3, pp. 33–37.) Experimentally determined polar diagrams are presented for aerials of side lengths between 0·5 and 1·5 λ, heights between 1 and 1·5 λ and angles between 60° and 240°. The characteristics are in fair agreement with curves calculated from the formulae given.

AUTOMATIC COMPUTERS

681.142 3140

Applications of a High-Speed Electronic Computer to a Business-Accounting Problem.—A. St. Johnston & S. L. H. Clarke. (*J. Brit. Instn Radio Engrs*, July 1954, Vol. 14, No. 7, pp. 293–302.)

681.142 3141

Digital Servomechanism controls Shaft Position.—L. T. Thomasson. (*Electronics*, Aug. 1954, Vol. 27, No. 8, pp. 134–139.) Devices for converting data from digital to analogue form are discussed; two experimental systems which convert binary-digital input signals into shaft-rotation angles are described. The converter functions as a closed-loop servomechanism in which the error-sensing portion is a digital computer. Information can be indicated remotely with an accuracy within 0·1%.

681.142 **3142**

A One-Dimensional Fourier Analog Computer.—L. V. Azaroff. (*Rev. sci. Instrum.*, May 1954, Vol. 25, No. 5, pp. 471–477.) The computer sums Fourier series having up to 30 terms, and can be used for double and triple summations by using standard trigonometric expansions.

681.142 : 517.9 **3143**

Solution of Second-Order Differential Equations and Partial Differential Equations using a Resistance Network.—R. Servranckx. (*Rev. HF, Brussels*, 1954, Vol. 2, No. 10, pp. 271–276.) Description of an instrument based on Liebmann's design (1954 of 1950), which has an accuracy within about 1 part in 10^3.

681.142 : 519.272.1 **3144**

Direct-Reading Electronic Correlator.—J. C. Pebay-Peyroula & P. Simon. (*J. Phys. Radium*, May 1954, Vol. 15, Supplement to No. 5, pp. 101A–108A.) Paper-strip recordings of two functions are read photoelectrically, and the electrical signals thus obtained are converted into pulses which, when coincident, actuate a computer. The correlation delay time can be varied up to any value from a lower limit set by the recording speed.

681.142 : 621-52 **3145**

Statistical Computers as applied to Industrial Control.—P. Huggins. (*J. Brit. Instn Radio Engrs*, July 1954, Vol. 14, No. 7, pp. 309–321.) Principles and circuit techniques are discussed; applications described include the control of the diameter of extruded plastic cable sheathing.

681.142 : 621.314.634 **3146**

The Selenium Rectifier in Digital Computor Circuits.—A. D. Booth & A. D. Holt. (*Electronic Engng*, Aug. 1954, Vol. 26, No. 318, pp. 348–355.) Results are reported of an investigation of the Birkbeck College computer with the object of replacing valves by more reliable elements where possible. Measurements indicate that ¼-in.-diameter Se-disk rectifiers are suitable for use as shift diodes, buffer isolators, gating elements, coincidence-sensing units and decoding-matrix elements, in computers where the frequency of operation does not exceed 30 kc/s.

681.142 : 621.316.313 **3147**

A New A.C. Network Analyser for the Solution of Problems arising in the Operation and Extension of Electrical Power Systems.—E. Fässler. (*Brown Boveri Rev.*, Nov./Dec. 1953, Vol. 40, Nos. 11/12, pp. 455–461.)

681.142 : 621.317.32 **3148**

An Analogue Computing Circuit for the Evaluation of the Ratio of Two Slowly-Varying Potentials.—R. L. Gordon. (*J. sci. Instrum.*, May 1954, Vol. 31, No. 5, pp. 166–169.) The circuit, based on the Miller integrator, is described in detail; the computed ratio is displayed as a meter deflection. The use of feedback reduces the sensitivity to valve-characteristic variations; the error is less than 1% of full-scale deflection within wide input limits. Computation of reciprocals and products may be performed by means of similar circuits. Several possible applications of the device are mentioned.

681.142 : 621.383 **3149**

The A.D.E. Photo-electric Integrator.—J. R. Lowe. (*Nature, Lond.*, 26th June 1954, Vol. 173, No. 4417, pp. 1222–1223.) The instrument, which is in the developmental stage, is capable of evaluating surface integrals of any function over a domain with boundaries not containing poles of the function. It comprises essentially a bottom-lit light-diffusing table with a photoplate grating and photoelectric cell arranged above; the grating represents the function and an opaque mask represents the domain of integration. Integrals of a bivariate normal distribution function over a domain with irregular boundaries have been obtained.

CIRCUITS AND CIRCUIT ELEMENTS

621.316.8.029.3 : 621.317.723 **3150**

Charge-Carrier Device as a High Ohmic Resistance.—W. Kossel, F. Leonhard & P. Volk. (*Z. angew. Phys.*, May 1954, Vol. 6, No. 5, pp. 213–215.) The principle of the two arrangements described is the movement of a conductor (a metal ball of capacitance C_k) to and fro at a specified frequency (n) in an e.s. field between two electrodes. The effective resistance, R, of the circuit is $1/n\,C_k$. In the first arrangement, the ball is fitted to the periphery of an insulated disk driven by a synchronous motor; in the second, the ball is free and its movement is controlled by an electromagnet. Details are given of the performance of the system operating in an electrometer circuit, with balls of different materials. With a ball 3 mm in diameter, frequency 50 cycles/minute, and electrode spacing 4 mm, $R = 2{\cdot}8 \times 10^{12}\Omega$.

621.316.86 : 537.312.6 **3151**

Thermistor Nomograph.—V. W. Bolis. (*Electronics*, Aug. 1954, Vol. 27, No. 8, p. 178.) Chart for finding values of thermistor resistance at given temperature. The accuracy is nearly as good as that of a slide rule.

621.318.4.042.12 **3152**

Demagnetization Coefficients of High-Permeability Cores.—M. A. Rozenblat. (*Zh. tekh. Fiz.*, April 1954, Vol. 24, No. 4, pp. 637–661.) Experimental determination of the dependence of demagnetization coefficients on geometrical dimensions of solid or laminated cores of rectangular cross-section and solid or hollow cylindrical cores. A semi-empirical formula for calculating the demagnetization coefficient of cylindrical, rectangular cross-section, and ellipsoidal cores is given and the calculated results are shown to be in good agreement with measurements.

621.318.57 **3153**

An Electronic Ratchet.—H. J. Moody & G. J. B. Crawford. (*Canad. J. Phys.*, May 1954, Vol. 32, No. 5, pp. 356–358.) When groups of nine evenly spaced pulses are applied to a decade scaler, a series of output pulses is obtained with separation increasing by one time unit for each pulse group. Application of groups of eight pulses gives separation increasing by two time units per group, while groups of eleven pulses decrease the separation by a single unit. The instrument described comprises two decade scalers and can provide a maximum separation of 98 time units for increasing intervals or 100 for decreasing intervals.

621.319.43 **3154**

Component Design Trends — New Variable Capacitors extend Tuning Range.—F. Rockett. (*Electronics*, Aug. 1954, Vol. 27, No. 8, pp. 130–133.) Over 200 different types of variable capacitor in production were surveyed. An outline is given of techniques used for obtaining low minimum capacitance and high maximum capacitance, adapting for operation at u.h.f., miniaturizing and pressurizing.

621.319.43 **3155**

A Simple Three-Terminal Micrometer Capacitor.—M. C. McGregor. (*J. sci. Instrum.*, May 1954, Vol. 31, No. 5, pp. 190–191.) Description of a variable capacitor

in which a micrometer spindle moves along the axis of a hollow cylinder which is coaxial with a cylindrical hole bored in the brass-block screen. Typical range is from 1 to 6 pF for a 1-in. movement of the spindle.

621.372 : 621.314.7 **3156**

Transistor Characteristic Parameters for Weak Alternating Currents.—H. Henker. (*Arch. elekt. Übertragung*, May 1954, Vol. 8, No. 5, pp. 213–216.) A method of representation is proposed, using an impedance matrix, which is completely symmetrical for all six transistor connections. Formulae derived for input impedance, current gain, etc., have the same form for all the six circuits. The method requires a new definition of the currents and voltages, but affords the possibility of extension to multielectrode systems. The setting-up of matrices for complex arrangements of resistors and transistors is illustrated.

621.372.2 **3157**

Multilayer Distributed Constant Delay Lines.—W. J. Carley. (*Tele-Tech*, May 1954, Vol. 13, No. 5, pp. 74–76 . . 102.) See 2257 of 1953 (Carley & Seymour).

621.372.5 **3158**

Synthesis of Passive Networks with n Pairs of Terminals specified by their Scattering Matrices.—Y. Oono & K. Yasuura. (*Ann. Télécommun.*, March–May 1954, Vol. 9, Nos. 3–5, pp. 73–80, 109–115 & 133–140.) The method described gives results different from those of Belevitch (1547 of 1952 and back references). Equivalent networks are represented by means of a uniquely defined 'regular' network matrix. Necessary and sufficient conditions for minimum phase shift are specified in terms of matrix theory, and the minimum number of elements, excepting ideal transformers, required in equivalent networks is determined. Relevant matrix theory is dealt with in an appendix. The method is extended to networks violating the reciprocity principle.

621.372.5 **3159**

Reciprocity Relations in Active 3-Terminal Elements.—J. Shekel. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1268–1270.) It is shown by matrix analysis that under small-signal conditions an active element such as a valve or transistor can be represented by an equivalent circuit comprising a triangle of resistances and a three-terminal gyrator. The active element is stable if one, and only one, of the resistances is negative. It is shown that the property of nonreciprocity is essential for an active three-terminal element to be stable.

621.372.5 **3160**

Notes on the Gyrator Problem.—W. Doebke. (*Arch. elekt. Übertragung*, May 1954, Vol. 8, No. 5, pp. 197–200.) The impedance transformation properties indicated by Tellegen (980 of 1949) as characteristic of the gyrator can also exist in ordinary quadripoles. The peculiar nature of the gyrator is indicated by the sign of the output current. Different conventions used in representing quadripole currents and voltages are discussed. It is proposed that the equations should be written in a way that takes into account the terminating impedances and the internal impedance of the source.

621.372.5 : 538.652 : 546.289 **3161**

Solution of the Field Problem of the Germanium Gyrator.—R. F. Mason. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 741–756.) Analysis is presented for the Hall-effect gyrator described by Mason et al. (1930 of 1953) treated as a two-dimensional boundary-value problem and assuming that only one type of carrier is involved and that there is no surface recombination. The efficiency is calculated as a function of electrode size, shape of boundary, and magnetic field strength. Some of the results have been checked experimentally with fields up to 22 000 gauss. The calculations have been carried out for even higher fields, and may be useful for studying materials with higher mobilities, such as InSb.

621.372.5 : 621.3.012.1 **3162**

Impedance Transformation by Four-Terminal Networks.—S. Fedida. (*Wireless Engr*, Aug. & Sept. 1954, Vol. 31, Nos. 8 & 9, pp. 204–214 & 239–249.) The geometrical interpretation of impedance transformations is considered in relation to the use of impedance charts and improved methods of impedance measurement.

621.372.5 : 621.3.016.35 **3163**

Intrinsic Stability: Conditions for Equivalence between a Quadripole including Active Elements and a Passive Quadripole.—J. M. Moulon. (*Câbles & Transm.*, April 1954, Vol. 8, No. 2, pp. 153–158.) There are two necessary conditions: (*a*) image impedances must be passive; (*b*) image attenuation must exceed the value of a certain function of the phase angle of the image impedance and the image phase-shift coefficient; in certain important cases this second condition reduces to a simple mathematical form.

621.372.5 : 621.376.3 : 621.3.018.78 **3164**

Distortion of a Frequency-Modulated Wave passing through a Mismatched Quadripole.—L. J. Libois. (*Câbles & Transm.*, April 1954, Vol. 8, No. 2, pp. 195–200.) Analysis is based on the transfer coefficient of the network and a formula is derived for nonlinear distortion in the general case. From this the percentage of odd and even harmonics generated and the upper limit of the distortion factor can be determined. Application of the formula in the case of transmission lines is illustrated.

621.372.5.015.3 : 621.376.3 **3165**

Transient Response in F.M.—I. Gumowski. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, p. 1267.) Correction to paper abstracted in 2337 of August.

621.372.54 **3166**

Response of a Low-Pass or Band-Pass Filter to a Voltage whose Instantaneous Frequency varies Linearly as a Function of Time.—P. Poincelot. (*C. R. Acad. Sci., Paris*, 19th July 1954, Vol. 239, No. 3, pp. 245–247.) Analysis is given based on a Fourier-integral representation of the input voltage. A formula derived for the output voltage is shown to be applicable in the case of a panoramic receiver in which the frequency is varied by 200 kc/s in 10^{-2} sec.

621.372.54 **3167**

Conformal Mapping for Filter Transfer Function Synthesis.—G. L. Matthaei. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, p. 1319.) Correction to paper abstracted in 357 of February.

621.372.54 : 621.396.822 **3168**

On the Filter Problem of the Power-Spectrum Analyzer.—S. S. L. Chang. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1278–1282.) In an analyser for determining the power spectrum of random noise, a signal derived by repeating a finite sample of the noise record is heterodyned with another signal whose frequency is swept over the whole spectrum, and the resultant is passed through a narrow filter and then detected. An investigation is made of the optimum filter response for minimizing the intrinsic error associated with the finite size of the sample; the lowest probable error for various types of filter is tabulated. The rate of the frequency sweep must be small compared to the half-bandwidth squared for the filter response to remain substantially the same as its steady-state response.

621.373.421 **3169**

The Bridge-Stabilized Transformerless Oscillator with Complex Amplification Factor.—W. Ziegler. (*Frequenz*, May 1954, Vol. 8, No. 5, pp. 144–159.) Oscillators of the type described by Zaiser (425 of 1944), with *RC* frequency-determining circuits, are discussed. The effect of complex transfer factor is investigated, and the conditions are determined under which oscillations at unwanted frequencies are suppressed without impairing the frequency stability of the wanted oscillation.

621.373.421.11 **3170**

Frequency Stable *LC* Oscillators.—J. K. Clapp. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1295–1300.) Literature on the subject is reviewed and attention is drawn to the chronological order of various publications. Simple theory is presented for the conditions governing oscillation and frequency stability.

621.373.43 **3171**

The Type-6218 Beam-Deflection Tubes as a Complex Pulse Generator.—K. Enslein. (*Rev. sci. Instrum.*, April 1954, Vol. 25, No. 4, pp. 355–358.) Type-6218 is the U.S.A. designation for the Type-E80T valve (2843 of 1953). Circuits for producing single, double, or multiple pulses with very short rise time are described.

621.373.43 **3172**

Contribution to the Mathematical Description of Relaxation Oscillations.—P. Jean. (*J. Phys. Radium*, Oct. 1953, Vol. 14, No. 10, p. 36S.) Differences and similarities between oscillations of relaxation and of van der Pol type are discussed. Relaxation oscillations can be represented by the van der Pol equation if the self-inductance term in the latter is neglected and a suitable transformation is made.

621.373.44 **3173**

20-Kilovolt Delta-Function Generator.—H. G. Heard. (*Rev. sci. Instrum.*, May 1954, Vol. 25, No. 5, pp. 454–458.) A 20-kV pulse is generated in a circuit comprising two series-connected hydrogen thyratrons arranged to constitute the inner conductor of a 50-Ω coaxial line. It is passed through 40 ft of RG-8U cable to a delta-function generator which includes a pulse-sharpening gap and differentiating stub. This generator reduces the pulse rise time to $<0{\cdot}6$ mμs and the pulse width to 2·5 mμs. Pulses of either polarity may be obtained.

621.373.52.029.3 **3174**

Analysis of Junction-Transistor Audio-Oscillator Circuits.—J. B. Oakes. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1235–1238.)

621.374.34 **3175**

A Clipper with Automatic Mark-Space Ratio Control.—A. B. Johnson. (*Electronic Engng*, Aug. 1954, Vol. 26, No. 318, pp. 364–365.) A rectangular wave with mark/space ratio independent of the amplitude and harmonic content of the input wave is produced by controlling the bias level of the first clipping stage by means of a special feedback circuit incorporating a mark/space ratio discriminator.

621.375.221.2 **3176**

Distributed Amplifiers: some New Methods for Controlling Gain/Frequency and Transient Responses of Amplifiers having Moderate Bandwidths.—H. G. Bassett & L. C. Kelly. (*Proc. Instn elect. Engrs*, Part III, July 1954, Vol. 101, No. 72, p. 237.) Discussion on 1359 of May.

621.375.223 **3177**

High-Frequency Compensation of *RC* Amplifiers.—F. A. Muller. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1271–1276.) A discussion with special reference to transient response. Optimum values are tabulated for the circuit parameters for some typical circuits and compensating arrangements. In a multistage amplifier simply compensated by means of a coil in the anode leads, the rise time can be reduced to 55–60% of the uncompensated value if the time constants of the stages are equal, and to 45% if the time constants are staggered.

621.375.23 **3178**

Design of the Duplex Feedback Amplifier.—J. Oizumi. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser.B*, June 1953–March 1954, Vol. 5, Nos. 1–4, pp. 1–50, 115–141 & 215–249.) A comprehensive discussion illustrated by a detailed account of the design of carrier-telephone repeater amplifiers.

621.375.9 : 537.312.8 **3179**

The Galvanomagnetic Amplifier.—H. J. Thuy. (*Arch. elekt. Übertragung*, May & June 1954, Vol. 8, Nos. 5 & 6, pp. 217–222 & 269–278.) Discussion of theoretical and practical aspects of an amplifier whose operation depends on the magnetic control of electrical resistance (Gauss effect). Such an arrangement is less noisy than magnetic or dielectric amplifiers at low temperature. Among metals, bismuth exhibits the greatest sensitivity to this effect. By using an appropriate material such as InSb the principle can also be applied to amplifiers for use at room temperature. The theoretically possible gain is 30–40 db at 90°K and 50–60 db at 20°K; corresponding values which have been obtained with experimental units are about 13 and 31 db.

621.376.22 + 621.376.32] : 621.385.029.64 **3180**

72Ω A/B Reflex Klystron Performance.—G. Zito. (*Z. angew. Math. Phys.*, 15th May 1954, Vol. 5, No. 3, pp. 252–260. In English.) From a series of measurements made while varying the anode and reflector voltages simultaneously, constant-frequency and constant-power V_a/V_r curves can be constructed. Typical curves for three modes of operation at 9·369 kMc/s are shown. With the aid of these curves extremely pure amplitude or frequency modulation can be achieved, by varying V_a and V_r simultaneously so that the ratio of their variations is constant; the change from a.m. to f.m. may be effected simply by altering the ratio. The maximum frequency shift with a.m. was about $\pm 1{\cdot}3$ Mc/s. With f.m., a frequency swing of 40 Mc/s was obtained with constant power output of 13 mW. An important application of the systems described is the modulation of signal generators for measurement purposes.

621.376.23 **3181**

A Broadband, Low-Level, Error-Voltage Detector.—M. L. Kuder. (*Rev. sci. Instrum.*, May 1954, Vol. 25, No. 5, pp. 464–468.) The unbalance of a carrier-frequency voltage in a bridge circuit having two inductive and two Ge-diode arms is used for detecting small d.c. or a.c. error signals. Sensitivity down to 1 mV and response within 1 μs are provided by the instrument, which is relatively free from zero drift. Application to high-speed multichannel sampling and to servo systems is discussed.

621.376.232 : 621.385.5 **3182**

Direct-Coupled Transitron.—F. A. Milne & E. J. Miller. (*Wireless Engr*, Sept. 1954, Vol. 31, No. 9, pp. 234–239.) Transitron arrangements are discussed in which the screen grid and suppressor grid of the pentode are connected via a resistance network. Various practical applications are possible as a result of a discontinuity in the I_a/V_g characteristic. Circuits for (*a*) detection of direct-voltage changes, e.g. amplifier-gain alarm, (*b*) detection of alternating-voltage changes, e.g. peak suppressors, and (*c*) rectification of voltages exceeding a

given level are considered. Careful design is necessary to overcome variations between individual valves, but a very sharp trigger action can be produced. The high sensitivity makes circuit economies possible.

621.376.32 : 538.614 3183

Microwave Single-Sideband Modulator using Ferrites.—J. Cacheris. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1242–1247.) The modulator uses a ferrite rod inserted in a waveguide section, and subjected to a rotating transverse magnetic field, as a 180° phase shifter. A transmission type and a reflection type are described; both are designed to shift the frequency of an X-band signal by 20 kc/s.

621.318.2 + 621.318.4 3184

Small Transformers and Inductors. [Book Review]—K. A. Macfadyen. Publishers: Chapman & Hall, London, 1953, 237 pp., 37s. 6d. (*Proc. phys. Soc.*, 1st May 1954, Vol. 67, No. 413B, pp. 445–446.) "There has long been the need for a book which treats the design of transformers for use at both power and communication frequencies on the basis of a common, systematic theory, and which so closely relates the design process to fundamental theory as to enable the non-specialist successfully to undertake the design of transformers for widely differing applications. The author has fulfilled this need most admirably."

GENERAL PHYSICS

530.145 3185

On the Nature of Waves.—F. Bopp. (*Z. angew. Phys.*, May 1954, Vol. 6, No. 5, pp. 235–238.) Critical discussion of classical theory indicating how an interpretation of the quantum theory can resolve the incompatibility of wave and particle concepts.

536.49 : 621.319.4 3186

Theory of Thermodielectric Effect.—B. Gross. (*Phys. Rev.*, 15th June 1954, Vol. 94, No. 6, pp. 1545–1551.) "A theory is put forth to explain the electrical effects which accompany phase changes occurring in dielectrics and aqueous solutions. Ionic movement in the interface is treated as a transition between energy levels separated by potential barriers. The height of the barriers and the value of the energy levels are supposed to be different for positive and negative ions. Such a model results in a net current flow across the solid-liquid interface. When the interface moves during a phase change of the system, the excess electric charges thus produced constitute space charges in the solid and surface charges in the liquid." See also 2621 of September (Dias Tavares) and back references.

537.122 3187

A New Classical Theory of Electrons: Part 3.—P. A. M. Dirac. (*Proc. roy. Soc. A*, 20th May 1954, Vol. 223, No. 1155, pp. 438–445.) The theory previously proposed (1574 and 3059 of 1952) is applied to a system comprising several interpenetrating streams of electricity moving in accordance with the equations of Maxwell and Lorentz. An action principle is set up, and the equations of motion are put in the Hamiltonian form. The Hamiltonian has some similarity to that for point-charge electrons but there is some discrepancy.

537.122 3188

A Theory of the Electron.—H. T. Flint & E. M. Williamson. (*Nuovo Cim.*, 1st May 1954, Vol. 11, No. 5, pp. 568–569. In English.) Further development of the theory proposed previously (2066 of July).

537.212 3189

The Electric Field of Conductors arranged parallel to Conducting Planes intersecting at a Given Angle.—H. Rösch. (*Arch. elekt. Übertragung*, May 1954, Vol. 8, No. 5, pp. 229–237.) Convenient formulae are obtained by considering the field as the resultant of those due to the multiple reflections of the conductor in the intersecting planes. These formulae are shown to agree with those derived by the method of conformal transformation.

537.3 3190

Anomalous Electron Scattering in Metals.—D. K. C. MacDonald & W. B. Pearson. (*Phil. Mag.*, May 1954, Vol. 45, No. 364, pp. 491–496.) "A semi-theoretical equation was proposed previously to account qualitatively for the thermoelectric power of metals and alloys, particularly at low temperatures. The consequences of this equation are now examined quantitatively in relation to experimental data on alloys of copper."

537.52 3191

Some Measurements of the Relative Dielectric Strength of Gases.—N. R. McCormick & J. D. Craggs. (*Brit. J. appl. Phys.*, May 1954, Vol. 5, No. 5, pp. 171–173.) Electronegative gases including SF_6 and Cl_2 were studied by measuring the breakdown voltages of sphere gaps with spacings of a few millimetres. Results are tabulated and discussed, taking nitrogen as comparison standard.

537.525.6 3192

Electron Energy Distributions in Stationary Discharges.—I. B. Bernstein & T. Holstein. (*Phys. Rev.*, 15th June 1954, Vol. 94, No. 6, pp. 1475–1482.) Extension of previous analysis [1407 of 1947 (Holstein)] to the case of a stationary discharge in a d.c. space-charge field. The effect of the space charge is to increase the proportion of high-energy electrons. This results in a higher ionization rate, but the effect is not large enough to account for low maintenance potentials observed in positive columns and in microwave discharges in inert gases.

537.533 : 621.38.032.212 3193

Electron Emission from Cold Metal Surfaces at Medium Field Strengths ($\sim 10^4$ V/cm).—K. Kerner & H. Raether. (*Z. angew. Phys.*, May 1954, Vol. 6, No. 5, pp. 212–213.) Measurements were made of the field emission of an Fe cathode at pressures $<10^{-5}$ Torr. The emission field-strength characteristic depends largely on the pre-treatment of the cathode material. Applying Schottky's equation a value of 1–2 eV is obtained for the work function.

537.533.8 : 546.46-31 3194

Energy and Temperature Dependence of the Secondary Emission of MgO.—A. J. Dekker. (*Phys. Rev.*, 1st June 1954, Vol. 94, No. 5, pp. 1179–1182.) The results reported by Johnson & McKay (114 of January) are interpreted quantitatively on the basis of a simple one-dimensional model.

537.56 3195

Collisional Effects and the Conduction Current in an Ionized Gas.—A. A. Ware. (*Phil. Mag.*, May 1954, Vol. 45, No. 364, pp. 547–549.) A note on the approximate expression derived by Westfold (115 of January) for the collision term in the current transport equation for a binary ionized gas in a strong magnetic field.

537.56 : 538.63 3196

Maxwellian Approximation to the General Magneto-ionic Theory of Plasmas with an External Electric and Magnetic Field.—R. Jancel & T. Kahan. (*J. Phys. Radium*, May 1954, Vol. 15, No. 5, pp. 382–383.) Analysis

is presented to show that a Maxwellian distribution of electron velocities occurs as a particular case in the theory developed previously (2364 of August and back references).

538.248 **3197**

Variation of Diffusion-After-Effect Field with Induction.—P. Brissonneau. (*C. R. Acad. Sci., Paris*, 26th July 1954, Vol. 239, No. 4, pp. 346–349.) As a consequence of the different behaviour of 90° and 180° walls, the curve representing the variation of diffusion-after-effect field with induction exhibits two horizontal regions; this is confirmed experimentally.

538.3 **3198**

General Formulae for the Theory of Polarized Media.—É. Durand. (*C. R. Acad. Sci., Paris*, 28th June 1954, Vol. 238, No. 26, pp. 2504–2506.) The classical equations of electromagnetic theory are generalized and are all derived from two fundamental formulae by a chain of definitions and identities.

538.3 **3199**

Reaction Concept in Electromagnetic Theory.—V. H. Rumsey. (*Phys. Rev.*, 15th June 1954, Vol. 94, No. 6, pp. 1483–1491.) A mathematical definition is given of a physically observable quantity termed the 'reaction' which is a measure of the force exerted by one e.m. source on another. The concept is used to obtain expressions for scattering coefficients, transmission coefficients and aperture impedances. The advantage of using this concept rather than the variational approach is illustrated by treating the problem of scattering by a dielectric body.

538.3 **3200**

Some Consequences of the Theory of Action at a Distance in Classical Electrodynamics.—P. Braffort, M. Spighel & C. Tzara. (*C. R. Acad. Sci., Paris*, 12th July 1954, Vol. 239, No. 2, pp. 157–160.) The energy taken by a free charge and by a harmonic oscillator is calculated on the absorber theory.

538.566 : 621.396.67 **3201**

Electromagnetic Field of a Dipole Source above a Grounded Dielectric Slab.—Y. T. Lo. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 733–740.) A theoretical investigation, using the method of integral transforms. Solutions in integral form are evaluated asymptotically by the saddle-point method; the distant field is found to be the resultant of a spherical space wave and a cylindrical surface wave. Calculated radiation patterns for some particular cases, with and without the dielectric slab, are presented.

538.614 : [546.562.26+546.712.26 **3202**

Faraday Effect at Centimetre Wavelengths.—N. Neprimerov. (*Zh. eksp. teor. Fiz.*, April 1954, Vol. 26, No. 4, p. 511.) A brief note on Faraday-effect measurements at 3·18 cm λ at field strengths up to 5 000 oersted, using a 12-pole symmetrical waveguide system (not described). Results of measurements on $CuSO_4.5H_2O$ and $MnSO_4$ are presented graphically.

538.691 **3203**

On the Nature of the Transcendental Curves Associated with the Relativistic Trajectories of Charged Particles.—L. Gold. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 691–697.) Analysis applicable to particles with moderate relativistic velocities, at which radiation loss is negligible. The equations of the trajectory are formulated for the general case of particles injected with arbitrary velocity into crossed electric and magnetic fields. The case of zero injection velocity is calculated explicitly. See also 3401 below.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.7 : 621.396.822.029.64 : 621.396.677.3 **3204**

Multiple-Element Interferometer for Locating Sources of Solar Noise at 4 000 Mc/s.—H. Tanaka & T. Kakinuma. (*J. phys. Soc. Japan*, May/June 1954, Vol. 9, No. 3, pp. 364–368.) The interferometer uses five aerials, each with a paraboloidal reflector of diameter 1·5 m, arranged at intervals of 6 m. The distribution of brightness observed at 4 kMc/s over the quiet sun is consistent with the conclusions that (*a*) the diameter of the r.f. disk is about 6% greater than that of the optical disk, and (*b*) the outer ring is about 2·5 times brighter than the optical disk of uniform temperature about $1{\cdot}9 \times 10^6$°K.

523.85 : 621.396.822 **3205**

A Method for the Measurement of the Distance of Radio Stars.—D. R. W. Williams & R. D. Davies. (*Nature, Lond.*, 19th June 1954, Vol. 173, No. 4416, pp. 1182–1183.) The method described depends on the absorption of the radiation from the radio stars by interstellar hydrogen at a frequency of about 1·42 kMc/s. Preliminary results are given for the two intense sources in Cygnus and Cassiopeia; the distance of the former is 9 500 parsecs, that of the latter is probably between 500 and 2 500 parsecs. The uncertainty will be reduced when more accurate measurements are made of the absorption spectrum.

523.852.2 : 621.396.822] : 523.165 **3206**

On the Nature of the Discrete Radio Sources.—R. Q. Twiss. (*Phil. Mag.*, May 1954, Vol. 45, No. 364, p. 549.) Correction to paper abstracted in 2380 of August.

550.385 : 523.746 **3207**

The Distribution of Great and Small Geomagnetic Storms in the Sunspot Cycle.—H. W. Newton & A. S. Milsom. (*J. geophys. Res.*, June 1954, Vol. 59, No. 2, pp. 203–214.) A statistical analysis of the occurrence of (*a*) great geomagnetic storms, (*b*) small storms with sudden commencements, and (*c*) small storms without sudden commencements, during the last seven sunspot cycles. Distribution curves for (*a*) and (*b*) agree closely with the averaged sunspot curve. For (*c*) the curve has no pronounced peak at sunspot maximum but reaches a high level two years later; these post-maximum storms, which are associated particularly with ionospheric disturbances, often show a 27-day recurrence which is not observed with the (*b*) and (*c*) types.

551.510.535 **3208**

The Aeronomic Problem of Oxygen Dissociation.—M. Nicolet. (*J. atmos. terr. Phys.*, July 1954, Vol. 5, No. 3, pp. 132–140.) The vertical distribution of O_2 above 100 km as determined from rocket data is discussed in terms of diffusion and mixing processes.

551.510.535 **3209**

Group Height Calculations in the Presence of the Earth's Magnetic Field.—J. M. Kelso. (*J. atmos. terr. Phys.*, July 1954, Vol. 5, No. 3, pp. 117–131.) A method of obtaining a theoretical $h'f$ curve avoiding direct numerical integration is described. It is based on integral formulae involving the derivative of height with respect to electron density and obtained as special cases of the Gauss-Christoffel quadrature formula (409 of 1953 and 2088 of July). Application to (*a*) linear, (*b*) parabolic, (*c*) cosine, and (*d*) arc-cosine distribution is illustrated and results are compared with exact calculations [1405 and 2009 of 1952 (Shinn & Whale) and 1414 of May (Shinn)]. A different method is described for the case of layer penetration.

551.510.535 **3210**

The Vertical Distribution of Electrical Conductivity in the Upper Atmosphere.—H. Maeda. (*J. Geomag. Geoelect.*, Nov. 1953, Vol. 5, No. 3, pp. 94–104.) Data obtained from rocket measurements are used to determine the vertical distribution of conductivity and its height-integrated values for the D, E and F regions. The greatest conductivity value is found for the E layer around 100 km, hence this region is probably the seat of the electrical currents producing diurnal magnetic variations.

551.510.535 **3211**

On the Law of the Variation of E-Region Maximum with the Zenith Distance of the Sun.—A. K. Saha. (*Indian J. Phys.*, Sept. 1953, Vol. 27, No. 9, pp. 431–438.) Analysis of f_0E records obtained at Calcutta for the years 1949–1952 indicates that the value of n in Chapman's formula $f_0\mathrm{E} = f_s(\cos\chi)^n$ varies between 0·15 and 0·50. The subsolar frequency undergoes similar variations. A seasonal component of variation was most marked in 1950 and 1951, and the mean trend of the variations follows the sunspot cycle. The departures from the Chapman law are attributed to changes in the height distribution of O_2 in the transition region.

551.510.535 **3212**

The Sporadic-E Layer at Kodaikanal.—S. Rangarajan. (*J. geophys. Res.*, June 1954, Vol. 59, No. 2, pp. 239–246.) Examination of ionospheric records shows that an E_s layer is almost always present during the day. Two main types are distinguished: (*a*) a patchy type giving well spread echoes; this occurs more regularly and frequently, has a marked diurnal variation, and resembles the constant-height type observed at Brisbane by McNicol & Gipps (1899 of 1951); (*b*) a blanketing type occurring mostly during the afternoon. Neither meteoric nor thunderstorm activity greatly influences the formation of either type. No correlation is observed between E_s and the geomagnetic field.

551.510.535 **3213**

Spread F over Hawaii.—G. Reber. (*J. geophys. Res.*, June 1954, Vol. 59, No. 2, pp. 257–265.) Analysis of records for the period 1944–1953, showing diffuse and irregular echoes from the F region, indicates a much greater frequency of occurrence of spread F at sunspot minimum than at sunspot maximum, this difference being most pronounced in winter. A marked latitude and a less marked longitude effect are exhibited.

551.510.535 : 523.854 : 621.396.822 **3214**

F-Scatter at Huancayo, Peru, and Relation to Radio-Star Scintillations.—H. W. Wells. (*J. geophys. Res.*, June 1954, Vol. 59, No. 2, pp. 273–277.) Analysis of *h'f* records for the period 1938–1945 reveals marked diurnal, seasonal and annual characteristics of F-region scatter. This effect occurs most frequently in the period four hours before to four hours after midnight and is most prevalent during local summer. Occurrence frequency was least during 1941–1942, increasing by a factor of 3–4 by 1945. Diurnal variations correspond closely to reported characteristics of radio-star scintillations; annual and seasonal trends are not in simple agreement.

551.510.535 : 537.562 **3215**

The Connection between Lunar Height Changes and Lunar Currents in the E Layer.—M. H. Johnson. (*J. geophys. Res.*, June 1954, Vol. 59, No. 2, pp. 247–251.) Height changes produced by vertical electronic diffusion in the presence of negative ions are considered. Application of the results to the E layer confirms the validity of previous qualitative conclusions (385 of 1953).

551.510.535 : 551.55 **3216**

The Analysis of Fading Records from Spaced Receivers.—J. A. Ratcliffe. (*J. atmos. terr. Phys.*, July 1954, Vol. 5, No. 3, pp. 173–181.) Fading records obtained in investigating ionospheric winds by the spaced-receiver method described by Mitra (96 of 1950) and Phillips (1916 of 1952) are discussed. Considerable variability in the records is to be expected even if the wind is constant in both direction and magnitude. Two particular one-hour records for vertical-incidence reflection from the E layer are analysed. One is consistent with constant-wind conditions, the other requires more detailed analysis.

551.510.535 : 551.55 **3217**

The Determination of the Velocity of Winds from Spaced Fading Experiments.—G. Newstead. (*J. atmos. terr. Phys.*, July 1954, Vol. 5, No. 3, pp. 182–185.) More detailed analysis referred to in 3216 above. If some assumption is made about the distribution of signal amplitude over the ground, the statistics of wind variation can be deduced.

551.510.535 : 551.55 : 523.5 : 621.396.96 **3218**

Systematic Wind Measurements at Altitudes of 80–100 km using Radio Echoes from Meteor Trails.—J. S. Greenhow. (*Phil. Mag.*, May 1954, Vol. 45, No. 364, pp. 471–490.) Wind drifts of ionized meteor trails were measured using a coherent-pulse doppler technique at a frequency of 36·3 Mc/s. Average wind speeds and directions were obtained over hourly intervals; results for September and October 1953 show semidiurnal and diurnal wind components corresponding to a clockwise rotation of the wind vector. The amplitudes and phases of these components are variable. A prevailing wind was also found, towards the east in September and towards the west in October. There is a positive wind velocity gradient of $\sim$2·7 m.sec^{-1} km^{-1} between 78 and 98 km height. Large irregularities in the wind were noted. Typical records are shown and the equipment is described.

551.510.535 : 621.3.087.4 **3219**

An Apparatus for the Detection of Weak Ionospheric Echoes.—S. Gnanalingam. (*Proc. Instn elect. Engrs*, Part III, July 1954, Vol. 101, No. 72, pp. 243–248.) F.m. apparatus is described, in which the principle of coherent integration is applied in the receiver. With transmitted power of 250 W and filter bandwidth of 1 c/s, signals are detected with attenuation of up to 10 nepers.

551.510.535 : 621.396.11 **3220**

Ionospheric Absorption Measurements during a Sunspot Cycle.—E. Appleton & W. R. Piggott. (*J. atmos. terr. Phys.*, July 1954, Vol. 5, No. 3, pp. 141–172.) Detailed discussion of the results of measurements referred to in 1679 of 1953 (Piggott). Variation of atmospheric absorption $|\log\rho|$ with frequency f, where ρ is the effective ionospheric reflection coefficient, is accounted for by magneto-ionic theory provided that $\nu^2 \ll (f + f_L)^2$, where ν is the electron collision frequency and f_L is the gyrofrequency corresponding to the vertical component of the geomagnetic field. Examination of diurnal variations shows the average value of n in the relation $|\log\rho| \propto (\cos\chi)^n$, where χ is the solar zenith distance, to be 0·75 against the value 1·5 given by simple theory; possible explanations of this are considered. Excessive absorption on certain groups of days during the months November–February is directly correlated with the occurrence of sporadic reflecting strata below E-layer height. Noon measurements over 18 years show a general correlation of $|\log\rho|$ with sunspot number R, more pronounced in summer than in winter. General conclusions drawn are that the normal absorbing

stratum is located in the D region, and sudden disturbances associated with solar flares are probably due to increased ionization in this layer.

551.594.5 3221

Magnetic Disturbances, Sporadic E, and Radio Echoes associated with the Aurora.—J. H. Meek & A. G. McNamara. (*Canad. J. Phys.*, May 1954, Vol. 32, No. 5, pp. 326–329.) Data obtained from simultaneous observations of visible aurora, the earth's magnetic-field variations, vertical- and oblique-propagation radio echoes, and v.h.f. radar echoes, are examined. Long-range h.f. and v.h.f. echoes cannot in general be correlated. Reflections in both frequency ranges have coincided with the appearance of low-level auroral arcs, which are associated with magnetic bays.

551.594.5 : 621.396.11 3222

Radio Echoes during Aurora.—A. G. McNamara & B. W. Currie. (*J. geophys. Res.*, June 1954, Vol. 59, No. 2, pp. 279–285.) Saskatoon data for 56 and 106 Mc/s [3308 of 1953 (Currie et al.)] are reassessed. Two aerials placed at heights giving maximum resolution between echoes corresponding to first- and second-lobe radiation were used to determine whether echoes on 56 Mc/s were due to ground scatter reflected from the lower ionosphere [2976 of 1953 (Harang & Landmark)]. Results show that practically all echoes were due to direct reflection from aurorae.

551.594.5 : 621.396.11.029.55 3223

Long-Range Radio Echoes from Auroral Ionization.—A. M. Peterson & R. L. Leadabrand. (*J. geophys. Res.*, June 1954, Vol. 59, No. 2, pp. 306–309.) Echoes believed to be from auroral ionization are consistently observed using pulse signals on frequencies 6·4, 12·9 and 17·3 Mc/s at the relatively low latitude of Stanford, California. Two types of echo are distinguished: discrete, of very large amplitude; and diffuse, of much smaller amplitude. Echo data show a marked correlation with visual aurorae and with magnetic activity, and also indicate that reflections occur at regions well above the E layer.

551.594.5 : 621.396.11.029.55 3224

The Location of the Auroral Absorption Zone.—V. Agy. (*J. geophys. Res.*, June 1954, Vol. 59, No. 2, pp. 267–272.) "A study of data from a chain of radio-wave field-strength recording stations along the 90th meridian suggests that the 'auroral absorption zone' coincides with the zone of maximum frequency of occurrence of visible aurora." The significance of the results for radio communications across the zone is discussed.

LOCATION AND AIDS TO NAVIGATION

534.88 : 534.321.9 : 621.396.96 3225

A Method for Ultrasonic SONAR of Plan-Position-Indication.—Y. Kikuchi. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser.B*, June 1953, Vol. 5, No. 1, pp. 77–86.) P.p.i. sonar equipment consists basically of several narrow-beam ultrasonic transducers spaced uniformly in a ring rotating very slowly, and switched rapidly between 'send' and 'receive' positions. The received pulses are used to modulate the brightness of the c.r. tube beam tracing out a spiral. In the experimental equipment described, the six transducers operated at a frequency of 50 kc/s and had a beam width of 7° each. A useful range of 200 m to several kilometres is expected for operations at sea. A p.p.i. photograph is reproduced.

621.396.93 : 551.594.6 3226

New Design of Radio Direction Finder for Locating Thunderstorms.—F. Horner. (*Met. Mag.*, May 1954, Vol. 83, No. 983, pp. 137–138.) Description of the main features of a twin-channel c.r.d.f. instrument operating at frequencies of about 10 kc/s and suitable for mobile and tropical use. Its performance is similar to that of earlier designs, but simplification has been achieved by restricting the frequency range and using straight receivers. An automatic selector is incorporated for co-ordinating observations from several stations.

621.396.933 3227

Measurement of Ships' Speeds by means of the Raydist Range Measuring Equipment.—(*Tijdschr. ned. Radiogenoot.*, May 1954, Vol. 19, No. 3, pp. 147–152.) An account of the method which was used for the first time on the S.S. 'United States' in 1952.

621.396.96 : 621.374 3228

False Echoes in Line-Type Radar Pulsers.—R. Lee. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1288–1295.) The operation of the d.c. resonant charging pulser is discussed and an explanation is given of the mechanism of the backswing which causes oscillation in the magnetron after the main pulse and thus gives rise to false echoes. Equations and curves are derived for predicting the presence or absence of echoes in a given pulser. The case of a pulser giving 4-μs pulses is treated as an example.

MATERIALS AND SUBSIDIARY TECHNIQUES

531.788.12 3229

A Thermistor McLeod Gauge for a Pressure Range 1–10^{-7} mm of Mercury.—R. S. Bradley. (*J. sci. Instrum.*, April 1954, Vol. 31, No. 4, pp. 129–130.)

535.215 : 546.48-31 : 537.311.33 3230

Optical Absorption Constant of Cadmium Oxide.—J. Stuke. (*Z. Phys.*, 8th May 1954, Vol. 137, No. 4, pp. 401–415.) The position, at room temperature, of the absorption edge depends largely on the method of manufacture of the specimen and on its thermal history. The position of the edge can be shifted by up to 0·5 eV by means of tempering; this is due to a shift of the exponential part of the absorption curve. The relation between the position of the absorption edge and electrical conductivity is also investigated. The results are discussed with reference to the crystal lattice.

535.215.3 : 538.639 : [546.28+546.289 3231

Photomagnetoelectric Effect in Germanium and Silicon.—H. Bulliard. (*Phys. Rev.*, 15th June 1954, Vol. 94, No. 6, pp. 1564–1566.) A study of the initial transient part of the effect in Ge indicates that the photomagneto-electric voltage passes through a maximum before reaching its steady-state value. Results of some experiments on Si are also reported. See also 2015 and 2016 of 1953 (Aigrain & Bulliard).

535.215.3 : 538.639 : 546.561-31 3232

Photomagnetic Effect in Cuprous Oxide at Low Temperatures.—A. P. Komar, N. M. Reinov & S. S. Shalyt. (*C. R. Acad. Sci. U.R.S.S.*, 1st May 1954, Vol. 96, No. 1, pp. 47–48. In Russian.) Results are reported of measurements at 4·2°K and 77°K in fields up to 24 000 oersted. The maximum photomagnetic e.m.f. observed at 4·2°K in a sample 40 mm long was ~90 V. The results are shown graphically and briefly discussed.

535.215.3 : 538.639 : 546.682.86 3233

Photoconductivity and Photoelectromagnetic Effects in InSb.—S. W. Kurnick, A. J. Strauss & R. N. Zitter. (*Phys. Rev.*, 15th June 1954, Vol. 94, No. 6, p. 1791.) Brief account of experiments; results are in agreement with theory developed by Moss et al. (748 of March).

535.37 3234

Phosphors Emitting Infrared Radiation.—G. F. J. Garlick & M. J. Dumbleton. (*Proc. phys. Soc.*, 1st May 1954, Vol. 67, No. 413B, pp. 442–443.) Eight phosphors with emission spectra in the infrared region beyond 1 μ have been produced, viz., Cu_2O, PbS, CdSe-Cu, ZnS-Cu, ZnS-Co, CdS-Cu, CdSHgS-Cu, and HgS.

535.37 3235

Luminescence of the System $\beta Zn_3(PO_4)_2$-$CD_3(PO_4)_2$:Mn.—A. L. Smith & A. D. Power. (*J. electrochem. Soc.*, May 1954, Vol. 101, No. 5, pp. 244–247.)

535.37 3236

Sensitized Luminescence of CaF_2:(Ce+Mn).—R. J. Ginther. (*J. electrochem. Soc.*, May 1954, Vol. 101, No. 5, pp. 248–257.)

535.37 : 535.341 3237

Determination of the Absorption Coefficient of Phosphor Powder.—V. V. Antonov-Romanovski. (*Zh. eksp. teor. Fiz.*, April 1954, Vol. 26, No. 4, pp. 459–472.) The absorption coefficient is determined from measurements of the diffuse-reflection coefficient, which is defined, and the known linear dimensions of the crystallites and the bulk-material refraction coefficient. The theory, based on that by Z. Bodó (*Acta phys. hungarica*, 1951, Vol. 1, No. 2, pp. 135–150), treats the phosphor layer as a pile of plane parallel homogeneous layers, and is developed for crystals of regular and of irregular form, i.e. one in which total internal reflection can occur. The calculated and experimentally determined results are compared and discussed in detail; actual phosphor layers include crystals of both regular and irregular shape.

535.37 : 537.228 3238

Interpretation of Electroluminescence Effects in an Excited Phosphor.—F. Matossi. (*Phys. Rev.*, 1st June 1954, Vol. 94, No. 5, pp. 1151–1156.) See 2284 of 1953.

535.37 : 546.472.21 3239

Dependence of Absorption and Luminescence Spectra of ZnS-Cu Phosphor on Cu Concentration.—M. N. Alentsev & A. A. Cherepnev. (*Zh. eksp. teor. Fiz.*, April 1954, Vol. 26, No. 4, pp. 473–478.) Analysis of the experimental results, which are shown graphically, indicates that the blue luminescence which occurs in the presence of excess Cu is due to a restoration of the pure ZnS luminescence and not to formation of new Cu luminescence centres.

535.376 : 546.431-31 3240

Cathodoluminescence Study of (BaSr)O.—K. Noga & K. Nakamura. (*J. phys. Soc. Japan*, May/June 1954, Vol. 9, No. 3, pp. 435–437.) Luminescence was excited by bombarding BaO, SrO and (BaSr)O films with a 250-V 2-mA electron beam. The bands in the (BaSr)O spectrum lay between the corresponding bands for BaO and SrO, thus supporting the view that the (BaSr)O is a homogeneous solid solution.

537.224 3241

Electret.—C. Yamanaka. (*J. phys. Soc. Japan*, May/June 1954, Vol. 9, No. 3, p. 425.) A brief report of experiments on carnauba-wax electrets; the results indicate that the effect depends on the ionization of the edges of the element as well as on the ionization of the interelectrode region.

537.224 3242

Studies of the Heterocharges of Electrets.—S. Wikström. (*Ark. Fys.*, 4th March 1954, Vol. 7, Part 3, pp. 213–220.) See 1071 of April.

537.227 3243

Possible Mechanism of Ferroelectric Domain Boundary Movement.—T. Nakamura. (*J. phys. Soc. Japan*, May/June 1954, Vol. 9, No. 3, pp. 425–426.)

537.227 : 546.431.824-31 3244

The Properties of Colloidal Ferroelectric Materials: Part 3 — Barium Titanate $BaTiO_3$.—M. Anliker, H. R. Brugger & W. Känzig. (*Helv. phys. Acta*, 1st May 1954, Vol. 27, No. 2, pp. 99–124. In German.) Investigations by means of X-ray diffraction, electron diffraction, electron microscopy and dielectric measurements are reported. The ferroelectric properties change gradually with crystal size. The transition from the polarized (tetragonal) phase to the unpolarized (cubic) phase occupies a temperature range which increases as particle size decreases. The tetragonal spontaneous strain does not completely vanish even at temperatures some hundreds of degrees above the Curie point of the macroscopic crystal (120°C). Deviations from normal ferroelectric behaviour are ascribed to structural differences between the interior and a surface layer of thickness about 100 Å. Part 2 : 1445 of May.

537.227 : 546.431.824-31 3245

Domain Clamping Effect in Barium Titanate Single Crystals.—M. E. Drougard & D. R. Young. (*Phys. Rev.*, 15th June 1954, Vol. 94, No. 6, pp. 1561–1564.) Permittivity measurements were made on crystals subjected simultaneously to a varying bias voltage and to a much weaker 20-kc/s voltage. An observed decrease of permittivity with decrease of average polarization is interpreted as due to a multidomain clamping effect.

537.227 : 546.817.831.4 3246

Threshold Field and Free Energy for the Antiferroelectric-Ferroelectric Phase Transition in Lead Zirconate.—A. P. de Bretteville, Jr. (*Phys. Rev.*, 1st June 1954, Vol. 94, No. 5, pp. 1125–1128.)

537.228.1 3247

Piezoelectric Properties of Lead Zirconate-Lead Titanate Solid-Solution Ceramics.—B. Jaffe, R. S. Roth & S. Marzullo. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 809–810.) Brief report of some experimental studies of the dependence of piezoelectric properties on the composition of the solution and on temperature.

537.228.1 : 548.0 3248

Elastic and Piezoelectric Coefficients of Dipotassium Tartrate (DKT).—R. Bechmann & S. Ayers. (*Proc. phys. Soc.*, 1st May 1954, Vol. 67, No. 413B, pp. 422–426.) The constants were determined by the method of Bechmann (128 of 1951), and their variation with temperature measured. A table is included comparing the properties of some zero-temperature-coefficient cuts of DKT, EDT and quartz.

537.311.31 : 539.234 3249

Hysteresis Phenomena exhibited by Rectifier Contacts and by Thin Films.—N. Nifontoff. (*C. R. Acad. Sci., Paris*, 5th July 1954, Vol. 239, No. 1, pp. 31–33.) Observed hysteresis of the I/V curves is attributed to the diffusion of impurity ions in metal/semiconductor barriers under the influence of applied voltage.

537.311.33 3250

Bound States in Dislocations.—R. Landauer. (*Phys. Rev.*, 1st June 1954, Vol. 94, No. 5, pp. 1386–1388.) An estimate is made of the trapping energy associated with elastic distortions.

537.311.33 **3251**

Graphical Representation of the Semiconductor Hall Effect.—L. P. Hunter. (*Phys. Rev.*, 1st June 1954, Vol. 94, No. 5, pp. 1157–1160.) "The semiconductor Hall effect is represented in terms of an ellipse relating the Hall mobility and resistivity. Various uses and extensions of this representation are given which serve to correlate the important features of the Hall effect in semiconductors. The effects of excess current carrier lifetime and the non-equality of Hall and drift mobility ratios are discussed."

537.311.33 **3252**

Some Experiments on Semiconducting Powders.—G. G. E. Low. (*Research, Lond.*, April 1954, Vol. 7, No. 4, p. S22.) The thermoelectric powers of *n*-type Ge and PbS and of *p*-type Ge, Si, and PbS were measured for various grain sizes and the results are shown graphically. With decreasing grain size, both magnitude and sign of the thermoelectric power changed for *n*-type materials, but only the magnitude changed for *p*-type materials, Ge and Si showing a decrease and PbS an increase.

537.311.33 : 538.63 **3253**

New Galvanomagnetic Effect.—C. Goldberg & R. E. Davis. (*Phys. Rev.*, 1st June 1954, Vol. 94, No. 5, pp. 1121–1125.) If a crystal carrying an electric current is placed in a magnetic field, an electric field will be induced normal to the current in the plane defined by the directions of the current and the magnetic field. The effect is termed planar Hall effect. Measurements on Ge single crystals are reported.

537.311.33 : 546.28 **3254**

Spin Resonance of Donors in Silicon.—R. C. Fletcher, W. A. Yager, G. L. Pearson, A. N. Holden, W. T. Read & F. R. Merritt. (*Phys. Rev.*, 1st June 1954, Vol. 94, No. 5, pp. 1392–1393.) Resonances were observed only in arsenic-doped Si samples which had been plastically deformed by compression at 1 000°C.

537.311.33 : 546.28 **3255**

Floating Zone Recrystallization of Silicon.—P. H. Keck, W. Van Horn, J. Soled & A. MacDonald. (*Rev. sci. Instrum.*, April 1954, Vol. 25, No. 4, pp. 331–334.) A method is described for zone melting and recrystallizing Si by induction heating. Single crystals with resistivities up to several hundred ohm.cm have been grown in this way.

537.311.33 : 546.28 : 535.215 **3256**

Photoconductivity in Gold-Doped Silicon.—R. Newman. (*Phys. Rev.*, 15th June 1954, Vol. 94, No. 6, pp. 1530–1531.) Measurements on *p*-type Si at temperatures of 20°, 77° and 195°K are reported.

537.311.33 : 546.289 **3257**

Conductivity and Hall Effect in the Intrinsic Range of Germanium.—F. J. Morin & J. P. Maita. (*Phys. Rev.*, 15th June 1954, Vol. 94, No. 6, pp. 1525–1529.) Measurements over the temperature range 250°–1 000°K are reported; the results are in good agreement with theory taking account of (*a*) the lattice-scattering mobility as determined between 100° and 300° and extrapolated to 1 000°K, (*b*) scattering by electron-hole collisions, (*c*) correction of carrier concentration for the change in energy gap width due to e.s. interaction of the carriers at temperatures over 500°K.

537.311.33 : 546.289 **3258**

Photon-Radiative Recombination of Electrons and Holes in Germanium.—W. van Roosbroeck & W. Shockley. (*Phys. Rev.*, 15th June 1954, Vol. 94, No. 6, pp. 1558–1560.) The spectral distribution of photon generation resulting from recombination is determined from the known optical properties of Ge by applying the principle of detailed balance. The value found for the thermal-equilibrium recombination rate at 300°K is $1{\cdot}57 \times 10^{13}$ cm^{-3} sec^{-1}. The temperature dependence of this and related parameters is shown graphically.

537.311.33 : 546.289 **3259**

Recombination of Holes and Electrons at Lineage Boundaries in Germanium.—F. L. Vogel, W. T. Read & L. C. Lovell. (*Phys. Rev.*, 15th June 1954, Vol. 94, No. 6, pp. 1791–1792.) Report of measurements made by the Morton-Haynes method described by Valdes (741 of 1953), in which carriers are liberated by light.

537.311.33 : 546.289 **3260**

Diffusion of Impurities in Germanium.—W. C. Dunlap, Jr. (*Phys. Rev.*, 15th June 1954, Vol. 94, No. 6, pp. 1531–1540.) Account of an experimental investigation using a method described previously [3134 of 1952 (Dunlap & Brown)], in which diffusion is determined by observing the formation of *p-n* junctions. The impurities studied were In, Ga, Al, As, B, P, Sb and Zn. Diffusion coefficients ranging from 10^{-12} cm^2/s to 10^{-9} cm^2/s at 900°C were found. The method is applicable to the study of surface and grain-boundary diffusion; the circumstances in which it is more suitable than the radioactive-tracer method are indicated.

537.311.33 : 546.289 **3261**

Measurement of the Surface Properties of Germanium.—J. B. Gunn. (*Proc. phys. Soc.*, 1st May 1954, Vol. 67, No. 413B, pp. 409–421.) 'External contacts' are defined as those in which a relatively low-resistance contact is made to the semiconductor surface layer without disturbing its properties. Three types are described: (*a*) electroplated Cu contacts to which connection is made either mechanically or by soldering at 80°C, (*b*) contacts of Ag dust either in the form of a conducting paint or used dry in a hole in a perspex block with a steel plunger pressing it against a Ge disk, and (*c*) contacts of aqueous electrolyte either absorbed in a disk of filter paper or in liquid form. Preliminary results of measurements involving these techniques indicate the existence of a transversely conducting layer separated from the interior of the Ge specimen by a rectifying barrier, but do not support the view that the inverse properties of point contacts can be simply related to those of the surface junction. A Ge filament transistor with one 'internal' and three 'external' contacts and capable of power amplification is described.

537.311.33 : 546.289 **3262**

Seebeck Effect in Germanium.—T. H. Geballe & G. W. Hull. (*Phys. Rev.*, 1st June 1954, Vol. 94, No. 5, pp. 1134–1140.) Measurements have been made over the temperature range 20°–375°K on a series of Ge single crystals having various excess amounts of either acceptor or donor atoms. Measured values of Seebeck voltage show a remarkable rise as the temperature is lowered below room temperature. Existing theory cannot account for this, and an alternative explanation is proposed based on theory to be published by Herring.

537.311.33 : 546.289 **3263**

Energy of the High-Lying Acceptor Level in Copper-Doped Germanium.—J. F. Battey & R. M. Baum. (*Phys. Rev.*, 1st June 1954, Vol. 94, No. 5, p. 1393.) Results of measurements are consistent with the premise of a partially populated level at about 0·3 eV above the valence band.

537.311.33 : 546.289 **3264**

Pressure Dependence of the Resistivity of Germanium.—W. Paul & H. Brooks. (*Phys. Rev.*, 1st June 1954,

Vol. 94, No. 5, pp. 1128–1133.) The resistivity of a sample of 35-Ω.cm Ge has been investigated at pressures up to 30 000 kg/cm² over the temperature range 25°–76°C, and at pressures up to 7 000 kg/cm² at temperatures down to −195°C. The results indicate an increase in total energy gap up to 15 000 kg/cm², and, for *n*-type material, a rapid rise in resistivity above that pressure. Alternative theoretical explanations are considered.

537.311.33 : 546.289 **3265**

The Change of the Refractive Index of Some Germanium Films Irradiated by Intense Light.—K. Ishiguro & T. Hayashi. (*J. phys. Soc. Japan*, May/June 1954, Vol. 9, No. 3, pp. 387–391.) Measurements were made on evaporated films of Ge, using a Rayleigh-Löwe interferometer. The refractive index increased when the colour temperature of the source was about 3 000°K and decreased when the temperature was about 1 000°K. The effects are attributed to variation of the number of bound electrons.

537.311.33 : 546.482.21 : 535.215 **3266**

Interpretation of the Abnormal Variation of the Photoconductivity of CdS as a Function of Illumination.—G. Wlérick. (*C. R. Acad. Sci., Paris*, 28th June 1954, Vol. 238, No. 26, pp. 2514–2516.) The nonlinearity of the conductivity/illumination curve is explained on the basis of an electron recombination mechanism involving thermal transitions.

537.311.33 : 546.482.21 : 535.215 **3267**

Significance of Deep Traps in the Formation of the Photoelectric Signal in Thin Films of Cadmium Sulphide.—G. Wlérick. (*C. R. Acad. Sci., Paris*, 19th July 1954, Vol. 239, No. 3, pp. 257–259.)

537.311.33 : 546.682.19 **3268**

Electrical Properties of InAs.—O. G. Folberth, R. Grimm & H. Weiss. (*Z. Naturf.*, Dec. 1953, Vol. 8a, No. 12, p. 826.) Conductivity and Hall-effect measurements are reported which confirm the semiconductor properties of InAs. The mobility of the electrons is about 50 times that of the holes.

537.311.33 : 546.682.86 **3269**

Significance of Conductivity Measurements on InSb.—O. G. Folberth & O. Madelung. (*Z. Naturf.*, Oct. 1953, Vol. 8a, No. 10, pp. 673–675.) Experimental results reported by Weiss (2707 of September) and by Tanenbaum & Maita (758 of March) are interpreted on the basis of curves showing the isothermal variation of conductivity as a function of electron or hole concentration.

537.311.33 : 546.86 : 539.234 **3270**

Semiconducting Films of Antimony.—J. Cohen. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 798–801.) A study was made of the electrical properties of thin films of Sb condensed on to surfaces at various temperatures. Negative temperature coefficients of resistance were found for films deposited on very cold surfaces. In general, reversible resistance changes occurred if the films were cooled below a temperature previously reached, while irreversible changes occurred if the films were heated above the temperature at which they were prepared. Neither the evaporation rate nor the thickness appeared to affect the activation energy. The observed effects are explained in terms of lattice-defect theory.

538.221 **3271**

Influence of the Thickness of the Weiss Domains on the Permeability of Iron between 0 and 7 000 Mc/s.—J. Benoit & E. Naschke. (*C. R. Acad. Sci., Paris*, 21st June 1954, Vol. 238, No. 25, pp. 2404–2405.) Continuation of work described previously (2984 of October). The thickness of the domains was determined from permeability measurements on Armco wires treated at various temperatures. The dependence of permeability on domain thickness disappears as the frequency is increased.

538.221 **3272**

Magnetic Viscosity in Precipitation Alloys: FeNiAl, Fe_2NiAl and Alnico.—J. H. Phillips, R. Street & J. C. Woolley. (*Phil. Mag.*, May 1954, Vol. 45, No. 364, pp. 505–523.)

538.221 : 621.318.134 **3273**

Thermomagnetic Investigation of Gadolinium Ferrite.—R. Pauthenet & P. Blum. (*C. R. Acad. Sci., Paris*, 5th July 1954, Vol. 239, No. 1, pp. 33–35.) Measurements were made of the spontaneous magnetization of $Fe_2O_3.Gd_2O_3$ at field strengths up to 19 600 oersted, over the temperature range 4°–700°K, using a method described previously [1397 of 1953 (Pauthenet)]. The magnetization falls to zero at three points in this temperature range.

538.221 : 621.318.134 **3274**

Thermomagnetic Study of Ferrites of Dysprosium and Erbium.—G. Guiot-Guillain, R. Pauthenet & H. Forestier. (*C. R. Acad. Sci., Paris*, 12th July 1954, Vol. 239, No. 2, pp. 155–157.) Experimental results indicate that the magnetic properties of these ferrites are closely similar to those of gadolinium ferrite.

538.221 : 621.318.134 **3275**

Interpretation of Magnetic Properties of Rare-Earth Ferrites.—L. Néel. (*C. R. Acad. Sci., Paris*, 5th July 1954, Vol. 239, No. 1, pp. 8–11.) The interpretation is based on splitting the lattice into a ferrimagnetic Fe-ion sublattice weakly coupled to a paramagnetic rare-earth-ion sublattice.

538.652 **3276**

The Approach to Saturation Magnetostriction.—L. Néel. (*J. Phys. Radium*, May 1954, Vol. 15, No. 5, pp. 376–378.) Discussion of theory developed by Lee (2988 of October).

538.652 **3277**

Contribution to the Study of Magnetostriction.—R. Vautier. (*Ann. Phys., Paris*, May/June 1954, Vol. 9, pp. 322–372.) Theory is presented, taking account of the various elementary phenomena contributing to the overall magnetostrictive effect. Apparatus for measuring the effect is described and measurements on Fe and Ni single crystals, Co ferrites, and mixed Mn-Zn ferrites are reported. Constrained magnetostriction is recognized as distinct from spontaneous magnetostriction in the Fe and Ni crystals; the two may act in opposite senses. Measurements in strong fields are necessary to observe the phenomena clearly. In the case of Co ferrites, measurements of the temperature variation of magnetostriction may afford a useful method for investigating the mechanism of magnetization. The measurements on high-μ ferrites indicate that there is no simple relation between permeability and magnetostriction.

546.431.824-31 **3278**

Phase Transitions in some Solid Solutions having Ferroelectric Properties.—G. A. Smolenski & V. A. Isupov. (*C. R. Acad. Sci. U.R.S.S.*, 1st May 1954, Vol. 96, No. 1, pp. 53–54. In Russian.) Results are reported for (*a*) $BaSnO_3$ in $BaTiO_3$, (*b*) $BaZrO_3$ in $BaTiO_3$ and (*c*) $SrTiO_3$ in $BaTiO_3$. The four states observed in (*a*) and (*c*) correspond to the cubic, tetragonal, orthorhombic and rhombohedral structure, respectively.

621.315.616 : 621.315.212 3279

Use of Foamed Materials for Insulation in High-Frequency Coaxial Cables.—L. Krügel. (*Fernmeldetech. Z.*, May 1954, Vol. 7, No. 5, pp. 221–226.) Foamed insulating materials having a polystyrol base may be used for television coaxial cables provided that special precautions are taken to prevent mechanical deformation of the cable. Other applications are limited by the mechanical properties.

621.791.9 : 537.311.33 3280

Some Techniques for making Stable Nonrectifying Contacts to Germanium and other Semiconductors.—W. M. Mitchell. (*J. sci. Instrum.*, April 1954, Vol. 31, No. 4, pp. 147–148.) For welding fine wires to either PbS, PbSe, or PbTe, an 80-μF capacitor charged to 15 V is discharged through the crystal and the wire, the discharge being repeated at higher voltage until contact resistance is between 1 and 10 Ω. For connection to Ge, the end of the wire must be tinned, and lactic acid applied at the connection before discharging the capacitor.

MATHEMATICS

517 3281

Addition Theorems for Spherical Waves.—B. Friedman & J. Russek. (*Quart. appl. Math.*, April 1954, Vol. 12, No. 1, pp. 13–23.) The problem considered is the determination of the scattered field when a plane wave is incident on a configuration of spheres. The first-order approximation is obtained by taking the excitation field to be the initial plane wave plus the zero-th order approximation to the scattered field. To carry out this approximation the scattered field from a sphere with centre O must be decomposed into incoming spherical waves for a second sphere with centre O'. Expansions of spherical wave functions for this purpose are derived.

517.7 3282

Common Elliptic Integrals and Functions.—R. Cazenave. (*Ann. Télécommun.*, April 1954, Vol. 9, No. 4, pp. 103–108.) A brief survey of the theory of elliptic functions and certain of their geometrical applications.

517.7 3283

Calculation of Common Elliptic Integrals and Functions.—R. Cazenave. (*Ann. Télécommun.*, May 1954, Vol. 9, No. 5, pp. 141–155.) Detailed exposition of interpolation and direct methods of evaluating Legendre integrals and Jacobi functions such as occur in potential and field problems. Degrees of approximation involved and ranges of validity are indicated. See also 3282 above.

517.944.3 3284

A Transform Method for Linear Time-Varying Systems.—J. A. Aseltine. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 761–764.) A method is described for finding new transformations applicable to one-point boundary-value problems. Examples of transformations derived, including Laplace, Mellin and Meijer, are presented.

519.24 : 530.162 3285

The Representation of Stationary Statistical Functions.—R. Becker. (*Z. angew. Phys.*, May 1954, Vol. 6, No. 5, pp. 231–235.) From the Fourier integral representing a stationary random process with average value zero, the relation between spectral distribution, correlation and mean square value over a fixed time interval is derived. Its application in calculations relating to shot effect, Brownian motion and resistance noise is illustrated.

519.272 3286

Generalization of the Wiener-Khintchine Theorem to Nonstationary Processes.—D. G. Lampard. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 802–803.)

MEASUREMENTS AND TEST GEAR

621.3.018.41(083.74) + 529.786 3287

Atomic Clocks and Frequency Standard on an Ammonia Line: Part 1.—K. Shimoda. (*J. phys. Soc. Japan*, May/June 1954, Vol. 9, No. 3, pp. 378–386.) "Various causes of errors in an atomic clock utilizing the 3–3 line of ammonia are examined theoretically and experimentally. A brief description of a Stark modulation atomic clock designed for experimental purposes is given. It is shown that the fractional error will exceed 1 part in 10^{-8}, unless high degree of frequency-insensitive multiplier output and excellent matching of waveguide to generator and detector are achieved."

621.3.018.41(083.74) + 621.396.91 3288

Precision Quartz Resonator Frequency Standards.—J. M. Shaull & J. H. Shoaf. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1300–1306.) Description of the N.B.S. primary standard of frequency. See 1731 of 1953.

621.3.018.41(083.74) + 621.396.91 3289

Standard Frequency Transmissions.—L. Essen. (*Proc. Instn elect. Engrs*, Part III, July 1954, Vol. 101, No. 72, pp. 249–255.) A short historical résumé of standard-frequency transmissions is given, and the results achieved with the British 0·5-kW MSF transmissions are discussed, with particular reference to the accuracies to be expected, both for the frequencies and the timing pulses transmitted. Coverage over the area within a radius of about 1 000 miles is satisfactory.

621.317.3 : 621.396.621.029.6 : 621.396.822 3290

A Continuous Monitor of Microwave Receiver Noise-Factor.—R. D. Holland & N. A. Godel. (*J. Brit. Instn Radio Engrs*, July 1954, Vol. 14, No. 7, pp. 322–331.) Technique described by Dicke for the measurement of microwave radiation (475 of 1947) is adapted. A small modulated noise signal is introduced into the receiver, a sample of the i.f. output is detected, and voltages in a narrow band around the modulation frequency are selected and amplified. This composite signal is applied to a coherent detector followed by a low-pass filter whose output is shown on a meter calibrated to give the noise factor. A design for use with an S-band radar system is described.

621.317.3.029.63/.64 3291

Simplified Method for the Determination of the Material Constants (ϵ, μ, σ, tan δ) for Solid, Liquid and Gaseous Substances, especially for Small Samples.—A. Esau & D. Prösdorf. (*Naturwissenschaften*, May 1954, Vol. 41, No. 9, p. 208.) The method is for use at decimetre wavelengths, and involves measurement of the node displacement caused by introduction of the sample, in a suitable container, into a coaxial line. Trolitul is recommended for the container material. Approximate formulae are derived from which the required physical constants can be simply calculated. Samples smaller than 1 cm^3 can be dealt with. The method can also be used for determining the thickness of thin metal layers. At centimetre wavelengths the same method can be used with waveguides.

621.317.321 3292

Measuring Small Voltage Changes.—J. P. Salter. (*Wireless World*, Sept. 1954, Vol. 60, No. 9, pp. 451–453.) Changes of the order of 0·1 V in the d.c. level of a

relatively high voltage can be measured by means of a circuit which in its basic form comprises a low-grid-conductance electrometer valve and a polystyrene-film capacitor, with polystyrene-insulated switch. Detailed practical circuits are shown, including a bridge arrangement for mains operation.

621.317.34.018.75 : 621.315.212 **3293**

0·05-Microsecond Pulse Echo Meter for Investigating Impedance Uniformity in 5/18 Coaxial Pairs.—P. Herreng. (*Câbles & Transm.*, April 1954, Vol. 8, No. 2, pp. 172–189.) Principles of the technique are given and equipment recently developed for tests on production lengths of cable is described. Pulses are trapezoidal, with rise time of 0·015 μs. Using distributed amplification in the receiver a gain of 68 db is attained at frequencies up to 80 Mc/s. Results of measurements made with pulses of duration 0·1 and 0·05 μs are compared; more detailed oscillograms are obtained with the shorter pulses.

621.317.38.029.64 **3294**

On Microwave Power Measurements.—E. Weber. (*Elektrotech. u. Maschinenb.*, 1st May 1954, Vol. 71, No. 9, pp. 254–259. In English.) Bolometer bridge arrangements are discussed. The observed nonlinear variation of resistance with bias power in a Wollaston-wire bolometer follows readily from the complete solution for the temperature distribution using the Langmuir formula for the cooling of thin wires. Measurements of microwave power by the superposition principle are subject to slight errors on account of this nonlinearity. If the ratio of bolometer wire length to λ is kept below 0·1 the error can be kept to $< 2\%$.

621.317.42 **3295**

The Measurement of Two-Dimensional Fields: Part 1 — Theory.—W. C. Elmore & M. W. Garrett. (*Rev. sci. Instrum.*, May 1954, Vol. 25, No. 5, pp. 480–485.) A two-dimensional magnetic field may be uniquely specified by listing all coefficients of the power-series expansion of its complex potential function. Experimentally, the first N coefficients may be derived from an N-point harmonic analysis of the radial component of field or gradient, as measured with a dipole or quadrupole search coil at N equally spaced angular positions about an arbitrary longitudinal axis. Refinements of the method for the determination of higher harmonics are discussed.

621.317.42 : 535.56 **3296**

Application of the Faraday Effect to Measurement of Magnetic Fields.—F. Hock. (*Z. angew. Phys.*, April 1954, Vol. 6, No. 4, pp. 151–153.) Use is made of the high Verdet's constant of magnetically saturated iron (382 500 deg/cm $\pm$ 2%) in the polarimeter-type instrument described. The rotation of the plane of polarization of light by a semitransparent iron layer 1 μ thick, deposited on a 3 mm diameter quartz disk, and placed inside a magnetic lens under test, is approximately 3·8 deg in an 18 000-gauss field.

621.317.42 : 621.384.612 **3297**

The Measurement of Two-Dimensional Fields: Part 2 — Study of a Quadrupole Magnet.—I. E. Dayton, F. C. Shoemaker & R. F. Mozley. (*Rev. sci. Instrum.*, May 1954, Vol. 25, No. 5, pp. 485–489.) Measurements on a quadrupole magnet for use in the design study of the strong-focusing synchrotron were made using the method of 3295 above.

621.317.45 **3298**

The Nondestructive Read-Out of Magnetic Cores.—A. Papoulis. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1283–1288.) See 2468 of August (Buck & Frank).

621.317.7 : 621.314.6 **3299**

Rectifiers in Electrical Measurements. Limits of the Field of Application.—H. Pfannenmüller. (*Arch. tech. Messen*, May 1954, No. 220, pp. 119–122.) A survey of the uses of various types of rectifiers in measurement circuits.

621.317.71/.72 **3300**

Multirange, Audiofrequency Thermocouple Instruments of High Accuracy.—F. L. Hermach & E. S. Williams. (*J. Res. nat. Bur. Stand.*, May 1954, Vol. 52, No. 5, pp. 227–234.) Two new instruments are described. The first, called a volt-ampere converter, is used with a d.c. potentiometer to make measurements of alternating voltage and current over wide ranges accurate to within 0·05% at frequencies up to 20 kc/s. The second is a multirange thermocouple volt-ammeter accurate to within 0·5% and incorporating simple circuits so that the thermal converter may be checked with the indicating instrument normally connected to it.

621.317.714 **3301**

An R.M.S. Milliammeter of Novel Design for the Measurement of Current from Zero to Video Frequencies.—H. B. Wood. (*J. sci. Instrum.*, April 1954, Vol. 31, No. 4, pp. 124–125.) Two thermistors form adjacent arms in a Wheatstone bridge. The current to be measured is applied to one thermistor, the temperature rise of which is proportional to the mean square value of the input current. The unbalance current is passed to a d.c. amplifier, and thence via a moving coil ammeter to the second thermistor, thus tending to restore the bridge balance. The ammeter indicates true r.m.s. current on a linear scale up to 10 mA; this range may be extended. The accuracy of indication is within $\pm$ 2% of full-scale deflection for frequencies from 0 to 7 Mc/s falling by 4% at 10 Mc/s.

621.317.714.029.62 **3302**

Thermocouple-Type Ammeters for Use at Very High Frequencies.—O. G. McAninch. (*Elect. Engng, N.Y.*, May 1954, Vol. 73, No. 5, pp. 431–435.) Sources of error in thermocouple instruments at high frequencies are discussed. Skin effect, impedance and resonance effects are reduced in an experimental design described. It incorporates short concentric terminals and a thin ribbon heating element folded back on itself, with mica insulation beween the two halves and the hot junction welded to the mid-point near the fold. The impedance of the instrument is about 6 Ω, it is consistently inductive and has no resonance points below 200 Mc/s. To be published also in *Trans. Amer. Inst. elect. Engrs, Communication and Electronics*, 1954.

621.317.72 **3303**

An Electric Field Meter with Extended Frequency Range.—L. G. Smith. (*Rev. sci. Instrum.*, May 1954, Vol. 25, No. 5, pp. 510–513.) A field-mill type meter is described which has two complementary sets of stators, so arranged as to ensure that a constant area is exposed to the field. Thus h.f. components up to 22 kc/s can be detected. Two ranges of sensitivity are provided, for maximum fields of 800 and 16 000 V/cm respectively. The instrument may also be used to measure potential at very high impedance.

621.317.729 : 537.291 **3304**

Automatic Electron Trajectory Plotting using the Electrolytic Tank Analogue.—B. O. Baker. (*Brit. J. appl. Phys.*, May 1954, Vol. 5, No. 5, pp. 191–195.)

621.317.75 **3305**

Design Planning of Equipment for the Visual Observation of Spectra of Electrical Oscillations.—S. M.

Khlytchiev. (*Radiotekhnika, Moscow*, May/June 1954, Vol. 9, No. 3, pp. 38–46.) Frequency-sweep spectrometers for r.f. and a.f. are considered. The preliminary considerations, such as the choice of the optimum oscillator frequency and the rate of change with time, and the shape of the c.r.o. timebase pulse, are discussed quantitatively and some circuit details are given. The characteristics of apparatus for r.f. and a.f. operation are summarized, the former covering the range 500 c/s–15 Mc/s in 9 bands, the latter the ranges 200 c/s–5, 10, or 20 kc/s.

621.317.75 : 621.396.3 **3306**

Radio Spectroscope.—A. Tchernicheff. (*Ann. Télécommun.*, April 1954, Vol. 9, No. 4, pp. 116–120.) An instrument for analysing the spectrum of radio-telegraph signals of any waveform at transmission speeds $\geqslant$ 50 bauds. See 3056 of 1951.

621.317.772 **3307**

An Audio Frequency Phase Meter.—F. P. Moss. (*Electronic Engng*, Aug. 1954, Vol. 26, No. 318, pp. 361–363.) Each of the two sine waves whose phase is to be compared is passed through a limiter circuit of the type described by Johnson (3175 above) in which it is converted to a square wave of unity mark/space ratio. The phase-difference reading is thus rendered largely independent of variations of signal level and even-harmonic distortion.

621.397.62.001.4 **3308**

Measurements on Television Receivers: Part 3 — Measurement of Transmission Characteristics in the Video-Frequency Circuits.—Macek. (See 3376.)

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

534.1.082.74 **3309**

A Self-Contained Electrical Vibration Meter — the Sinus Vibrator.—A. Johansson. (*IVA, Stockholm*, 1954, Vol. 25, No. 5, pp. 204–208.) The instrument described has an electrodynamic pickup with permanent magnet, and uses the energy of the vibration under examination as its only power supply. Accuracy is good enough for laboratory measurements.

534.321.9 **3310**

Ultrasonic Developments.—(*Wireless World*, Sept. 1954, Vol. 60, No. 9, pp. 448–450.) Brief review of various special-purpose ultrasonic echo-sounding equipments, some of which were discussed at the Oxford convention of the British I.R.E. while others were shown at the Manchester exhibition of the Institution of Electronics. A beam-steering system using a transducer with a multisection $BaTiO_3$ line associated with an *LC* delay line is described.

534.321.9 : 620.179.1 **3311**

Improvements in Ultrasonic Flaw Detection.—G. Bradfield. (*J. Brit. Instn Radio Engrs*, July 1954, Vol. 14, No. 7, pp. 303–308.) Improvements to apparatus developed at the National Physical Laboratory are described, including (*a*) a mode changer made of heavy material in the form of a laminated assembly, (*b*) damping, loading and circuitry for piezoelectric crystals to give improved discrimination and to reduce the adverse effects of rough surfaces, and (*c*) ultrasonic-beam-steering devices.

536.58 : 621.38 **3312**

A Time-Proportional Electronic Thermostat.—(*Tech. News Bull. nat. Bur. Stand.*, May 1954, Vol. 38, No. 5, p. 71.) The temperature-sensing element may be a resistance thermometer or a thermistor, and is connected in an a.c. bridge. The error signal together with a sawtooth voltage is applied to a synchronous detector whose output operates a trigger circuit actuating a relay in the heater circuit. Deviation from the control temperature causes variation of the fraction of the cycle during which heating power is applied. Using this device, the temperature of an oil bath has been held within $\pm$ 0·001°C of 28°C over a period of months.

620.17 **3313**

Nondestructive Testing of Materials.—(*Z. Metallkde*, April 1954, Vol. 45, No. 4, pp. 145–249.) This special issue gives papers describing ultrasonic, magnetic, electromagnetic and electronic methods of testing and sorting metals, and includes a survey of nondestructive testing methods used in America.

621-52 : 681.142 **3314**

Statistical Computers as applied to Industrial Control.—Huggins. (See 3145.)

621.317.39 **3315**

Industrial Metal Detectors with Special Reference to Sorting of Ores and Coal.—T. G. Charles. (*IVA, Stockholm*, 1954, Vol. 25, No. 5, pp. 209–220.) The ASDET is a simple search-coil-type detector developed in the A.S.E.A. laboratories. A standard 4-valve amplifier, requiring no adjustment, is used in conjunction with a range of coils to cover all reasonable requirements.

621.317.727 : 681.142 : 623.55 **3316**

Precision Potentiometers for Analog Computers.—D. G. Blattner. (*Bell Lab. Rec.*, May 1954, Vol. 32, No. 5, pp. 171–177.) The functions of precision potentiometers in gunlaying control systems are outlined and an illustrated description of drum and spiral types is given. Specially selected high-resistance wire is wound, 200 or 300 turns per inch, on cards varying in length from 5 to 90 in. and with a core of stress-free hard rubber ground to uniform thickness. A typical unit has an error of about 6 yd at a range of 20 miles.

621.365.54† **3317**

A Survey of Applications of British Industrial High-Frequency Induction-Heating Equipment and their Economic Aspect.—(*Metallurgia, Manchr*, May 1954, Vol. 49, No. 295, pp. 223–229.)

621.374.32 : 621.387.4 **3318**

A Count-Rate Meter.—E. W. Pulsford. (*Electronic Engng*, Aug. 1954, Vol. 26, No. 318, pp. 356–359.) Details are given of a circuit embodying automatic correction for losses caused by finite resolving time.

621.383.087.252 **3319**

Monitoring of High-Speed Phenomena.—F. Früngel. (*Z. angew. Phys.*, April 1954, Vol. 6, No. 4, pp. 183–192.) An account is given of stroboscopic and pulsed-image-converter methods of observation of high-speed non-luminous and luminous phenomena, respectively, and applications are described and illustrated by photographs. Technical information on suitable equipment is given.

621.384.611 **3320**

Concentration of a Cyclotron Beam by Strong-Focusing Lenses.—F. B. Shull, C. E. MacFarland & M. M. Bretscher. (*Rev. sci. Instrum.*, April 1954, Vol. 25, No. 4, pp. 364–367.) Part of the divergent beam from the Washington University cyclotron has been concentrated by means of a pair of strong-focusing magnetic lenses, at distances up to 411 cm beyond the end of the cyclotron; increase of the beam intensity by a factor of about eight has been achieved.

621.384.611 **3321**

Cyclotron Beam Energy Determination by a Time-of-Flight Method.—J. H. Manley & M. J. Jakobson. (*Rev. sci. Instrum.*, April 1954, Vol. 25, No. 4, pp. 368–369.)

621.384.611 **3322**

The Acceleration of Heavy Ions in a Fixed-Frequency Cyclotron.—D. Walker, J. H. Fremlin, W. T. Link & K. G. Stephens. (*Brit. J. appl. Phys.*, May 1954, Vol. 5, No. 5, pp. 157–164.) A mechanism of acceleration is described which leads to a continuous energy distribution of the final ions of high charge. The beam current of high-energy ions can be increased by increasing the pressure of gas in the cyclotron tank to increase the probability of stripping.

621.384.611 **3323**

The University of Washington Sixty-Inch Cyclotron.—F. H. Schmidt, G. W. Farwell, J. E. Henderson, T. J. Morgan & J. F. Streib. (*Rev. sci. Instrum.*, May 1954, Vol. 25, No. 5, pp. 499–510.) An account is given of the special mechanical and electrical design features and of the steps taken to achieve satisfactory operation.

621.384.612 **3324**

Magnetic Deflector for the Bevatron.—B. T. Wright. (*Rev. sci. Instrum.*, May 1954, Vol. 25, No. 5, pp. 429–431.) A device designed for the production of an external proton beam from the bevatron.

621.384.612 **3325**

Proposal of a Synchrotron with a Double Vacuum Chamber.—G. Salvini. (*Nuovo Cim.*, 1st May 1954, Vol. 11, No. 5, pp. 555–558. In English.) On the basis of the observed reduction in the diameter of the beam as its energy increases, a design is proposed in which acceleration is accomplished in two stages, the second chamber being much smaller than the first, with consequent reduction of the requirements in respect of constructional material and excitation energy.

621.384.612 : 621.3.078.4 **3326**

A Servo-Drive for Accurate Speed Control.—D. E. Caro, J. Y. Freeman & L. U. Hibbard. (*J. sci. Instrum.*, May 1954, Vol. 31, No. 5, pp. 170–173.) Description, including complete circuit diagram, of speed control for the rotating capacitor in the Birmingham proton-synchrotron r.f. system. The servo-drive system consists of a phonic motor excited by a synchronous signal picked up from the rotor teeth. The response time of the motor to applied voltages controlling the torque is 1 ms. The advantages of the phonic motor in this application are noted.

621.384.622 **3327**

Determination of the Axial Field of an Alvarez-Type Linear Accelerator.—W. Chahid. (*C. R. Acad. Sci., Paris*, 5th July 1954, Vol. 239, No. 1, pp. 42–44.)

621.385.833 **3328**

High-Resolution Replicas and Their Application.—T. Hibi & K. Yada. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 712–719.) Improved methods are described for preparing two-step replicas for use in electron microscopy.

621.385.833 **3329**

Potential Distribution of Symmetrical Cylindrical Electron Lenses.—G. D. Archard. (*Brit. J. appl. Phys.*, May 1954, Vol. 5, No. 5, pp. 179–181.) "Expressions are developed for the distribution of axial potential and potential derivatives in the two-dimensional 'unipotential' electron lens. Comparison is made with expressions obtained in simpler cases, and an example is illustrated."

621.385.833 **3330**

Summarized Proceedings of a Conference on Electron Microscopy — London, November 1953.—(*Brit. J. appl. Phys.*, May 1954, Vol. 5, No. 5, pp. 165–170.)

621.387.424 **3331**

Effect of Dead Time of G-M Counter Tubes on the Direct Indication of the Time-Average of Pulse Frequency.—P. Nenning. (*Z. angew. Phys.*, April 1954, Vol. 6, No. 4, pp. 145–150.)

621.43 : 621.376.3 **3332**

Measurement of Pressure [in internal combustion engines] **by Capacitor Indicator.**—E. Gourski. (*Rev. HF, Brussels*, 1954, Vol. 2, No. 10, pp. 268–270.) The variations of pressure modulate the frequency of a h.f. carrier. To ensure stable operation, filter and voltage-amplitude-regulator stages precede demodulation.

681.82 **3333**

Electronic Music.—(*Tech. Hausmitt. Nordw Dtsch. Rdfunks*, 1954, Vol. 6, Nos. 1/2, pp. 4–56.) Special issue including the following papers:—

Terminology of Electronic Music (pp. 5–7).—W. Meyer-Eppler. Definitions of the principal types of instrument are given and a classification is suggested.

Technical Equipment of the Electronic Music Studio [in Cologne Broadcasting House] (pp. 8–15).—F. Enkel.

Filter Circuits for the Electrical Production of Sound (pp. 18–23).—K. H. Adams.

Mathematical Acoustic Bases for the Composition of Electronic Music (pp. 29–39).—W. Meyer-Eppler.

Notation in Electronic Music (pp. 52–54).—H. Eimert, F. Enkel & K. Stockhausen.

PROPAGATION OF WAVES

621.396.11 : 551.510.535 **3334**

Ionospheric Absorption Measurements during a Sunspot Cycle.—Appleton & Piggott. (See 3220.)

621.396.11 : 551.594.5 **3335**

Radio Echoes during Aurora.—McNamara & Currie. (See 3222.)

621.396.11.029.55 : 551.594.5 **3336**

The Location of the Auroral Absorption Zone.—Agy. (See 3224.)

621.396.11.029.55 : 551.594.5 **3337**

Long-Range Radio Echoes from Auroral Ionization.—Peterson & Leadabrand. (See 3223.)

621.396.11.029.62/.63 **3338**

Basic Ground-Wave Propagation Characteristics in the Frequency Band 50–800 Mc/s.—J. A. Saxton. (*Proc. Instn elect. Engrs*, Part III, July 1954, Vol. 101, No. 72, pp. 211–214. Discussion, pp. 221–224). Full paper. See 2492 of August.

621.396.11.029.62/.63 **3339**

Ground-Wave Field-Strength Surveys at 100 and 600 Mc/s.—J. A. Saxton & B. N. Harden. (*Proc. Instn elect. Engrs*, Part III, July 1954, Vol. 101, No. 72, pp. 215–221. Discussion, pp. 221–224.) Full paper. See 2492 of August. See also 1928 of June (Saxton).

621.396.81 **3340**

Field-Strength Calculation.—K. Suda. (*Wireless Engr*, Sept. 1954, Vol. 31, No. 9, pp. 249–251.) A brief explanation is given of the 'equivalent conductivity' method for calculating field strength over mixed paths. The

equivalent conductivity is derived from Sommerfeld's 'numerical distance', which in turn is determined from the path parameters. Results are in good agreement with values measured in England, Denmark and Japan.

621.396.81 **3341**

Reflection Coefficients of Irregular Terrain.—K. Bullington. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1258–1262.) Fading due to ground reflections over radio relay paths is discussed. Considerable experimental data were obtained during the survey for the U.S. transcontinental microwave system. Variation of signal strength with aerial height was measured using 57-in. paraboloids on portable 200-ft towers, and the ground reflection coefficients were hence determined. For most of the repeater sections the value of this coefficient at 4 kMc/s lay between 0·2 and 0·4. No simple relation was found between the path profile and the observed reflection coefficient; the statistical relation previously pointed out by Rice (664 of 1952) is accepted.

621.396.81.029.51/.53 **3342**

A Survey of Ground-Wave Propagation Conditions in South Africa.—R. W. Vice. (*Trans. S. Afr. Inst. elect. Engrs*, April 1954, Vol. 45, Part 4, pp. 139–156. Discussion, pp. 156–159.) Ground-wave propagation characteristics at frequencies up to 1 Mc/s can be predicted with the aid of the ground-conductivity map and the conductivity/frequency curve. Norton's curves (1596 of 1942) and Millington's theory (1758 of 1949) of propagation over inhomogeneous ground were used in the determination of ground conductivity and should be used in field-strength predictions based on the ground-conductivity map given for South Africa. Deviations due to local effects were generally less than 3 db, but in mountainous terrain diffraction losses may have to be taken into consideration. Field strength variations due to time variations of ground conductivity and refraction in the atmosphere were negligible.

RECEPTION

621.376 : 621.396.82 **3343**

Simultaneous Detection of Signal and Interference by Amplitude Detectors and by Phase Detectors operating in a Linear Noninertial Mode of Detection.—E. I. Manaev. (*Radiotekhnika, Moscow*, May/June 1954, Vol. 9, No. 3, pp. 19–32.) Results are presented of a theoretical and experimental investigation of detecting signals in the presence of one or more sinusoidal interference voltages or fluctuation (noise) voltages. Simple and sufficiently accurate formulae are given showing the suppression of the noise for arbitrary correlation at the detector input. Experimental and calculated results are shown graphically.

621.396.62 : 621.396.812.3 : 519.272.15 **3344**

Suppression of Fluctuation Interference in the Correlation Method of Reception.—M. I. Karnovski. (*Radiotekhnika, Moscow*, May/June 1954, Vol. 9, No. 3, pp. 3–11.) Expressions derived for the signal/noise ratio in the correlation method of reception [Lee et al. (730 of 1951)] and the corresponding ratio at the output of a bandpass filter are compared.

621.396.621 **3345**

The High-Accuracy Logarithmic Receiver.—T. H. Chambers & I. H. Page. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1307–1314.) Design of receivers using the method of successive detection with progressive limiting to give output-voltage increments proportional to input-voltage ratios is discussed. Each i.f. stage is operated as an infinite-impedance detector with unity gain for high-level signals and as a linear amplifier for low-level signals; d.c. degeneration is used for stabilization. Three receivers with weak-signal bandwidths of 1·8, 6·5 and 9·5 Mc/s respectively are described.

621.396.621 : 621.376.2/.3 **3346**

Combination F.M./A.M. Receivers.—G. H. Russell. (*Wireless World*, Sept. 1954, Vol. 60, No. 9, pp. 431–436.) The transmission standards for the projected B.B.C. v.h.f. f.m. service are indicated. 100% modulation corresponds to 75 kc/s deviation, maximum modulation frequency is 15 kc/s, and pre-emphasis corresponding to a time constant of 50 μs is to be used. From a preliminary list it appears that carrier frequencies of stations serving the same area are separated by 2·2 Mc/s. Field strength is expected to be at least 800 μV/m in towns and about 250 μV/m in the country. Receiver sensitivity of the order of 10 μV and a selectivity characteristic of −3 db at $\pm$150 kc/s are considered acceptable. For sets receiving medium-wave and long-wave a.m. as well as the f.m., two tuners controlled by a single knob, two i.f. chains and normally two detectors are required. Practical circuits are illustrated showing switching arrangements.

621.396.621.029.6 : 621.396.822 : 621.317.3 **3347**

A Continuous Monitor of Microwave Receiver Noise-Factor.—Holland & Godel. (See 3290.)

621.396.822.1 : 621.396.61 **3348**

A Particular Case of Cross-Modulation in the Field of High-Power Transmitters.—Schellmann & Vogt. (See 3384.)

621.396.823 **3349**

Industrial Interference: Sources, Measurement and Elimination.—C. Févrot & J. F. Ulmo. (*Rev. gén. Élect.*, Dec. 1953, Vol. 62, No. 12, pp. 567–575.) Suppression of 'conducted' interference by means of filters is discussed; the attenuation produced depends on the impedance of the lines in which the filters are inserted. A range of filters should be available, for various current ratings, frequency bands and attenuation values. Because of the difficulty of measuring the radiation field, the interference voltage in conductors is measured instead. Results are reported of measurements on typical electrical machinery.

STATIONS AND COMMUNICATION SYSTEMS

621.3.018.78 : 621.376.3 **3350**

Phase Distortion introduced by Distortion of a Frequency-Modulated Wave.—P. J. M. Clavier. (*Câbles & Transm.*, April 1954, Vol. 8, No. 2, pp. 190–194.) Under conditions such that Libois' quasistationary approximation (448 of 1951) is valid, the propagation time of the modulated signal does not depend on the signal frequency. For the case of echo phenomena, an approximate formula is derived giving the upper limit of delay distortion.

621.376.3/.4 **3351**

Spectrum Width in Frequency and Phase Modulation.—A. M. Zaezdnyi. (*Radiotekhnika, Moscow*, May/June 1954, Vol. 9, No. 3, pp. 47–49.) Simple approximate expressions for the spectrum width are given for signals with a modulation index between 3 and 50, the spectrum being bounded by points at which the amplitude is 1, 5 or 10% of the amplitude maximum.

621.376.5 **3352**

Theoretical Fundamentals of Pulse Transmission: Part 2.—E. D. Sunde. (*Bell Syst. tech. J.*, July 1954, Vol. 33, No. 4, pp. 987–1010.) The limitation of pulse transmission rates by system imperfections is further

examined, and a comparison is made of the performance of double- and vestigial-sideband systems. Limitation of channel capacity by characteristic distortion and by random noise is discussed. Part 1: 2763 of September.

621.39.001.11 : 621.376.5 **3353**

Intermodulation in Pulse Communication Systems.—P. Marcou. (*Ann. Télécommun.*, May 1954, Vol. 9, No. 5, pp. 122–125.) A general expression for the output from a square-law detector contains terms representing useful signal, noise and intermodulation products. The effect of the latter on pulse shape, position and polarity is illustrated and the general principles of decoding in the presence of noise are discussed with reference to Loeb's duality principle (2215 of July). The advantage of using p.p.m. or p.w.m. is indicated.

621.396.3 : [621.376.52 + 621.376.55 **3354**

Frequency Spectra of Tone Telegraphy Systems with Amplitude and Phase Keying.—L. I. Yaroslavski & A. Yu. Lev. (*Radiotekhnika, Moscow*, May/June 1954, Vol. 9, No. 3, pp. 64–71.) The frequency spectra are calculated for the case when the rate of keying is of the order of the tone frequency used. Application of the results shows that the power contained in a signal using a $\pi/2$ phase shift is approximately 1·8 times the power contained in the corresponding a.m. signal of equal bandwidth.

621.396.4 **3355**

Two-Channel Frequency [-shift] **Radiotelegraphy.**—I. F. Agapov. (*Radiotekhnika, Moscow*, May/June 1954, Vol. 9, No. 3, pp. 50–63.) The system considered is similar to the Twinplex system described by Buff (*Elect. Commun.*, March 1952, Vol. 29, No. 1, pp. 20–33). Two 2-element mark-space channels are combined to form on a frequency scale a single 4-element channel where four audio frequencies represent the four possible mark-space combinations. The basic combiner circuit is described and channel bandwidth, distortion and operating speed are discussed. The system is in use on all radio-link trunk lines in the U.S.S.R. See also 3038 of October (Buff).

621.396.5.029.63 : 621.396.812.3 **3356**

Single-Channel System of Frequency Diversity.—D. D. Howard. (*Electronics*, Aug. 1954, Vol. 27, No. 8, pp. 158–161.) In a system for a.m. telephony the r.f. energy is spread over an u.h.f. channel by frequency-modulating the carrier with a tone before performing the amplitude modulation. Analysis for propagation under two-path conditions indicates that the system may reduce fading over some line-of-sight paths.

621.396.712 + 621.396.61.029.51 **3357**

Very-High-Power Long-Wave Broadcasting Station.—C. E. Smith, J. R. Hall & J. O. Weldon. (*Proc. Inst. Radio Engrs*, Aug 1954, Vol. 42, No. 8, pp. 1222–1235.) Illustrated description of the Voice of America station CAST, near Munich, which began regular operation in August 1953. A diesel power plant gives 5·2 MW. Twin 500-kW transmitters are provided; the outputs can be used separately or combined. Overall efficiency is $> 50\%$. Modulation is at low level. The a.f. response is flat within 0·5 db from 100 c/s to 5 kc/s. A 12-in.-diameter coaxial transmission line feeds an 837-ft top-loaded tower; the ground system consists of 100 miles of No. 6 Cu wire and extends out 0·5 mile from the tower.

621.396.721.029.55 **3358**

Modern Walkie-Talkie for Emergency Use.—B. Howlett. (*R.S.G.B. Bull.*, May 1954, Vol. 29, No. 11, pp. 511–512, 516.) Description of a 28-Mc/s transceiver using a DCC90 double-triode, one section of which acts as oscillator/superregenerative-detector, the other as modulator/a.f. amplifier. A range of half a mile was obtained in a heavily built-up area with high interference level.

SUBSIDIARY APPARATUS

541.136.22 **3359**

The Behaviour of Standard Cells in Conditions which include the Generation of Appreciable Current.—L. Hartshorn & F. A. Manning. (*J. sci. Instrum.*, April 1954, Vol. 31, No. 4, pp. 115–118.) Measurements made on Weston-type standard cells generating currents of 1, 10 or 100 μA for varying periods of time are reported, from which the voltage stability attainable under these conditions may be estimated.

621.311.6 : [621.314.63 + 621.314.7 **3360**

Transistors and Junction Diodes in Telephone Power Plants.—Chase, Hamilton & Smith. (See 3387.)

621.311.6 : 621.314.7 : 621.387.424 **3361**

Transistor Power Supply for Geiger Counters.—A. R. Pearlman. (*Electronics*, Aug. 1954, Vol. 27, No. 8, pp. 144–145.) A unit is described comprising junction transistors in a class-C amplifier circuit, operating from a 3-V battery and supplying 5μA at 700 V.

621.311.6 : 621.375.222 **3362**

Bias Supplies for Direct-Coupled Circuits.—J. H. Reaves. (*Electronics*, Aug. 1954, Vol. 27, No. 8, pp. 172–173.) Details are given of power-supply arrangements using special transformers with low shunt capacitance, thus permitting operation at above-earth potentials in direct-coupled amplifiers.

621.311.6 : 621.385.029.64/.65 **3363**

Stabilized H.V. Power Supply. Application to Millimetre-Wave Klystrons.—J. Mevel. (*J. Phys. Radium*, May 1954, Vol. 15, Supplement to No. 5, pp. 109A–112A.) A circuit is described in which the series stabilizer valve is inductively coupled to the error amplifier. An output of 20 mA at 4 kV can be provided.

621.362 : 523.7 **3364**

Solar Thermoelectric Generators.—M. Telkes. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 765–777.) Physical characteristics relevant to their usefulness for thermocouple materials have been determined for various metal alloys and compounds. The efficiencies of flat-plate-type solar-energy collectors in combination with such thermocouples is evaluated; the value of 0·63% obtained using ZnSb-type alloys in combination with a Bi alloy was ten times as great as that obtained with commercially available chromel *P* in combination with constantan. Using concentrating lenses, the efficiency obtained with the best alloy combination was 3·35%. The maximum economically permissible cost of thermoelectric generators is evaluated.

TELEVISION AND PHOTOTELEGRAPHY

621.397.2 **3365**

Waveform Responses of Television Links.—N. W. Lewis. (*Proc. Instn elect. Engrs*, Part III, July 1954, Vol. 101, No. 72, pp. 258–270.) For testing 405-line television links having a nominal upper cut-off frequency of 3 Mc/s, a set of four test signals has been used experimentally during the past three years with satisfactory results. All the signals have a 1-V peak-to-peak amplitude and include normal 0·3-V line-synchronizing pulses of 10-μs duration and 10-kc/s repetition frequency. Typical examples of waveform responses are shown. Two

complementary methods of specification of waveform response are proposed, one for rapid routine-test purposes and the other to meet the more precise requirements of acceptance tests. Both are framed in terms of a rating factor, the value of which can be varied to provide any desired degree of stringency.

621.397.26 : 621.396.65.029.64 **3366**

The Manchester-Kirk o' Shotts Television Radio-Relay System.—G. Dawson, L. L. Hall, K. G. Hodgson, R. A. Meers & J. H. H. Merriman. (*Proc. Instn elect. Engrs*, Part III, July 1954, Vol. 101, No. 72, pp. 273–275.) Digest of paper abstracted in 2784 of September.

621.397.5 : 535.623 **3367**

Colour Television Broadcasting in the U.S.A.—C. G. Mayer. (*Electronic Engng*, Aug. 1954, Vol. 26, No. 318, pp. 342–347; *J. R. Soc. Arts*, 23rd July 1954, Vol. 102, No. 4930, pp. 729–744; discussion, pp.744–747.) An outline of the R.C.A. system and brief account of the present state of colour television in the U.S.A. For details of the system see *Proc. Inst. Radio Engrs*, Jan. 1954, Vol. 42, No. 1.

621.397.5 : 535.623 **3368**

Colour Television: some Subjective and Objective Aspects of Colour Rendering.—G. T. Winch. (*Proc. Instn elect. Engrs*, Part III, July 1954, Vol. 101, No. 72, pp. 255–257.) Discussion on 1818 of 1953.

621.397.5 : 535.623 **3369**

N.T.S.C. Signal Specifications.—(*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, p. 1321.) Correction to paper noted in 1199 of April.

621.397.5(94) **3370**

Groundwork of TV Practice — the Television Code or Synchronizing Signals.—E. G. Beard. (*Philips tech. Commun., Aust.*, 1954, No. 2, pp. 11–17.) Includes details of the synchronizing signals specified by the Australian authorities.

621.397.611 : 778.5 **3371**

[16-mm] **Narrow-Film Scanner for Television.**—H. Kante & R. Krug. (*Fernmeldetech. Z.*, May 1954, Vol. 7, No. 5, pp. 230–231.) Brief description of a flying-spot film scanner, used in the Berlin-Tempelhof television station, in which the continuous film motion is compensated by means of a rotating 12-sided prism.

621.397.611 : 778.5 : 535.623 **3372**

Continuous Film Scanner for Monochrome or Color.—E. H. Traub & J. F. Fisher. (*Electronics*, Aug. 1954, Vol. 27, No. 8, pp. 152–157.) Arrangements are described for using a flying-spot system with rotating-polygon optical compensation of film movement [2238 of July (Traub)] to obtain a colour signal. The photoelectric head comprises three photomultipliers, two dichroic mirrors, a plane mirror, and three colour filters. Gamma correction circuits are described.

621.397.62 **3373**

Large Television Screen.—M. Likhachev & R. Shtromberg. (*Radio, Moscow*, May 1954, No. 5, pp. 36–38.) Description of the 3m × 4m projection-television installation in the Moscow cinema 'Ermitazh'.

621.397.62 : 621.385.032.44 **3374**

Series Heater Strings for TV Receivers.—F. Roberts. (*Electronics*, Aug. 1954, Vol. 27, No. 8, pp. 126–129.) When valve heaters are arranged in series, failures may occur as a result of current and voltage surges during the warm-up period due to inequalities in the rate of change of heater resistance. An arrangement for investigating the transients oscillographically is described. The surges can be reduced by grouping the heaters in the string on the basis of their warm-up time. See also *Trans. Inst. Radio Engrs*, July 1954, No. PGBTR-7, pp. 39–46.

621.397.62 : 621.385.5 **3375**

Valves for use in Band III Television Tuners.—Hampson & Neville. (See 3417.)

621.397.62.001.4 **3376**

Measurements on Television Receivers: Part 3 — Measurement of Transmission Characteristics in the Video-Frequency Circuits.—O. Macek. (*Arch. tech. Messen*, May 1954, No. 220, pp. 101–104.) Methods of determining the amplitude/frequency, phase/frequency and pulse-transmission characteristics are briefly described. The relation between the amplitude of the video-frequency signal at the demodulator and the control voltage at the c.r. tube is discussed.

621.397.62.002.2 **3377**

Adjustment Procedures for Color TV Production.—C. T. McClane. (*Electronics*, Aug. 1954, Vol. 27, No. 8, pp. 140–143.)

621.397.621 **3378**

A Television Deflection Unit with Castellated Ferroxcube Cores.—(*Philips tech. Commun., Aust.*, 1954, No. 2, pp. 18–19.)

621.397.74 : 621.397.335 **3379**

Pulse Distribution in TV Network Origination.—J. S. Auld & A. Gallonio. (*Electronics*, Aug. 1954, Vol. 27, No. 8, pp. 166–168.) Description of arrangements for use at a studio centre for feeding synchronizing and blanking pulses to the various studios, projection rooms, monitoring and picture recording points.

621.397.743.029.63 **3380**

Considerations relating to a Plan for a Television Transmitter Network for Band 4 (470–585 Mc/s) [in the Federal German Republic].—K. Buchta. (*Frequenz*, May 1954, Vol. 8, No. 5, pp. 137–143.) The need is emphasized for giving careful consideration to receiver design when planning the geographical and frequency distribution of the television transmitters. The choice of receiver i.f. is considered from the point of view of protection from oscillator radiation and other types of interference and the provision of high selectivity. Examination of the problem is based on previous proposals to use an i.f. of 38·9 Mc/s for the picture and 33·4 Mc/s for the sound. Single- and double-heterodyne receivers are considered, and cases of particular frequency relations are investigated. Some specific recommendations are tabulated.

621.397.8 : 535.735 **3381**

Relationship between Critical Flicker-Frequency and a Set of Low-Frequency Characteristics of the Eye.—H. de Lange Dzn. (*J. opt. Soc. Amer.*, May 1954, Vol. 44, No. 5, pp. 380–389.) See also 1841 of 1953.

621.397.9 **3382**

Moving-Target Detector.—J. L. McLucas & R. D. Laughlin. (*Electronics*, Aug. 1954, Vol. 27, No. 8, pp. 169–171.) A simple arrangement for observing moving objects at a remote location comprises an image dissector with rotating-mirror scanner and photocell pickup and a special c.r.-tube viewing device on which the image is produced by a raster of vertical bars. A typical scanning rate is one raster per sec; the bandwidth transmitted is much less than for ordinary industrial television. Applications include intruder detection and surveillance of assembly line.

TRANSMISSION

621.396.61 : 621.372.512 **3383**

Coupling Circuits for Transmitters.—A. Simon. (*Fernmeldetech. Z.*, May 1954, Vol. 7, No. 5, pp. 241–246.) The frequency variations of the voltage ratio, the effective resistance and reactance of various untuned and tuned h.f. coupling circuits, including frequency-compensated *LCR* circuits, are calculated and the results are tabulated and presented graphically. The frequency-compensated circuits are suitable for wide-band coupling (e.g., 4–30 Mc/s), but large change of the reactance with frequency may occur.

621.396.61 : 621.396.822.1 **3384**

A Particular Case of Cross-Modulation in the Field of High-Power Transmitters.—G. Schellmann & K. Vogt. (*Fernmeldetech. Z.*, May 1954, Vol. 7, No. 5, pp. 232–234.) Combination frequencies were observed at f_1–f_2, $2f_1$–f_2, $2f_1 + f_2$, and higher frequencies, with the transmitter at Weisskirchen (Taunus) operating on a frequency $f_1 = 872$ kc/s and that at Heiligenstock on $f_2 = 593$ kc/s. The respective power outputs of the two transmitters were 150 kW and 100 kW; the distance between aerials was 9 km. The presence of the Weisskirchen modulation on the Heiligenstock carrier was also observed. Using direction-finding equipment operating at $2f_1$–f_2 the source of the cross-modulation was traced to the Weisskirchen transmitter and found to be due to the high voltages picked up by the aerial and fed back to the wide-band Doherty-type output-stage anode load.

621.396.61.029.51 + 621.396.712 **3385**

Very High-Power Long-Wave Broadcasting Station.—Smith, Hall & Weldon. (See 3357.)

621.396.61.029.55 **3386**

Radio Transmitters in the American Cable and Radio System.—F. D. Webster. (*Trans. Inst. Radio Engrs*, July 1954, Vol. CS-2, No. 2, pp. 122–132.) Illustrated description of transmitters for telephone and telegraph point-to-point service at frequencies between 4 and 26 Mc/s, one with 7·5 kW and the other with 30 kW output power.

VALVES AND THERMIONICS

621.314.63 + 621.314.7] : 621.311.6 **3387**

Transistors and Junction Diodes in Telephone Power Plants.—F. H. Chase, B. H. Hamilton & D. H. Smith. (*Bell Syst. tech. J.*, July 1954, Vol. 33, No. 4, pp. 827–858.) Discussion indicates that semiconductor junction diodes and transistors have a wide field of application in power conversion and control. The dependence of the characteristics on temperature is a difficulty not yet entirely overcome; thermistors, nickel-wire resistors and suitable circuit arrangements can be used to provide temperature compensation. In most cases the regulating circuits described take their own power supply directly from the regulated output.

621.314.63.029.6 **3388**

Negative Resistance arising from Transit Time in Semiconductor Diodes.—W. Shockley. (*Bell Syst. tech. J.*, July 1954, Vol. 33, No. 4, pp. 799–826.) Detailed examination of the production of negative resistance in semiconductor diodes is based on consideration of the 'impulse impedance'. The investigation is relevant to the design of 'dissected amplifiers' [2901 of October (Shockley & Mason)] for operation at frequencies higher than those for which transistors are suitable. Particular structures discussed include (*a*) a 'minority-carrier delay diode' comprising a *p-n-p* structure, in which both types of carrier are effective, and (*b*) a unipolar diode which is again a *p-n-p* structure, but in which only one type of carrier is effective. Theory developed by Krömer (2821 of 1953) is discussed; hole mobility may become negative at very high field strength. Negative resistance characteristics can also be achieved by a convergent configuration of the diode.

621.314.7 **3389**

Theory of Diffusion-Type and Drift-Type Transistors: Part 1 — The Quadripole Matrix for Low Frequencies.—H. Krömer. (*Arch. elekt. Übertragung*, May 1954, Vol. 8, No. 5, pp. 223–228.) The quadripole matrix representation of a drift-type *p-n-p*-junction transistor (1605 of May) is developed. The four quadripole admittances are derived from the equations expressing the flow of holes through the base, taking account of the decrease of base thickness as the collector voltage rises. The ordinary diffusion-type transistor is included as a special case. As compared to the diffusion type, the drift type has a current amplification factor closer to unity, lower collector admittance, and lower feedback. The results are compared with those of Early (1244 of April).

621.314.7 **3390**

Extension of the Theory of the Junction Transistor.—E. S. Rittner. (*Phys. Rev.*, 1st June 1954, Vol. 94, No. 5, pp. 1161–1171.) Examination of Shockley's theory (379 of 1950) shows that it is valid for the emitter and collector regions for all values of current, but for the base region only for extremely small current values. The theory for the base region is extended to apply to arbitrary injection level, and to take account of the effect of surface recombination. Surface recombination velocity should increase with injection level, and the α cut-off frequency at high injection level should be approximately twice that for very low injection level for transistors with plane-parallel junctions.

621.314.7 : 546.289 **3391**

Developmental Germanium Power Transistors.—E. G. Roka, R. E. Buck & G. W. Reiland. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1247–1250.) An alloyed-junction transistor is described, capable of delivering several watts at temperatures from normal to 130°F. It is sealed in a metal case, the collector being soldered directly to the bottom of the case and the base and emitter leads being brought out via glass/metal seals. A method of mounting the transistor on a chassis is shown which provides effective heat transfer. Maximum collector current is of the order of 1 A and maximum collector voltage is 60 V. Collector I/V characteristics obtained at mounting-base temperatures of 75° and 175°F are shown.

621.314.7 : 621.373.52 **3392**

Internal Transistor Oscillations.—H. E. Hollmann. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, p. 1323.) See 2540 of August.

621.314.7 : 621.396.822 **3393**

Note on Shot and Partition Noise in Junction Transistors.—A. van der Ziel. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 815–816.) Discrepancies between theoretical and experimental values of noise figure found by Montgomery & Clark (1248 of April) are removed by taking partition noise into account.

621.383.2(083.7) **3394**

I.R.E. Standards on Electron Devices: Definitions of Terms Related to Phototubes, 1954.—(*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1276–1277.) Standard 54 I.R.E. 7 S1.

621.385 **3395**

Control-Grid Currents in Radio Receiving Valves.—E. Watkinson. (*Proc. Instn Radio Engrs, Aust.*, June

1954, Vol. 15, No. 6, pp. 139–143.) "The effects of 'contact potential' on the operating conditions of a valve and its circuit are described, with particular reference to the operation of battery valves under zero-bias or 'grid-leak bias' conditions. Reverse grid currents, their causes and effects are also discussed and precautions that may be taken to minimize variations of valve operating conditions by these currents are given."

621.385.002.2 **3396**

Foreign Tube Design Techniques.—T. H. Briggs & F. R. Michael. (*Tele-Tech*, July 1954, Vol. 13, No. 7, pp. 58–60, 104.) Valve manufacturing techniques used in Europe are analysed from the point of view of possible improvements in U.S. methods.

621.385.004.15 **3397**

A Study of Some of the Properties of Materials affecting Valve Reliability.—E. A. O'D. Roberts. (*Proc. Instn elect. Engrs*, Part III, July 1954, Vol. 101, No. 72, pp. 197–205. Discussion, pp. 205–209.) The mechanism of fracture in glass envelopes is briefly analysed and empirical relations are established between the probability of fracture and valve age, both for normal and for special-quality valves. A similar analysis for fractures at welded metal joints yields similar results. The concept of safe amplitude of stress or strain under vibration is applied to study fatigue fractures in metal components and in mica spacers, and the design and manufacturing features which determine the most dangerous stress amplitudes are explained. Improvements in the manufacturing process to minimize fractures of all types are described.

621.385.029.6 **3398**

A New Electron Tube: the Strophotron.—H. Alfvén & D. Romell. (*Proc. Inst. Radio Engrs*, Aug. 1954, Vol. 42, No. 8, pp. 1239–1241.) An experimental transit-time valve is described, the operation of which combines density modulation of the electron beam with control of the electron drift velocity in a direction perpendicular to the oscillatory motion, electrons being withdrawn from the r.f. field at an instant favourable from the efficiency point of view. The desired electron motion is produced by crossed electric and magnetic fields, as in the trochotron. The valve has a frequency range of about an octave without mechanical tuning.

621.385.029.6 **3399**

The Helix as a Backward-Wave Circuit Structure.—D. A. Watkins & E. A. Ash. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 782–790.) The impedance of the retarding helix is an important factor in the design of backward-wave oscillators. Curves are derived showing approximately the variation of the impedance with the ratio of circumference to free-space wavelength, for single and bifilar helices. It is shown that if in two tape helices the gap width of one is equal to the tape width of the other, their backward-wave impedances are equal.

621.385.029.6 **3400**

Study of the Static Properties of Magnetron-Type Space Charges.—J. L. Delcroix. (*Ann. Phys., Paris*, May/June 1954, Vol. 9, pp. 269–321.) A detailed theoretical study is made for magnetrons of various configurations, particularly coaxial-cylinder types, both plain and inverted, with axial and circular magnetic fields. Experiments are described which demonstrate the transitions between the different states. A Brillouin regime is found to exist for all the types considered, while the existence and number of the bidromic regimes depend on the particular type of magnetron. See also 1210 of 1953 and back references.

621.385.029.6 : 538.691 **3401**

Relativistic Dynamics of a Charged Particle in Crossed Magnetic and Electric Fields with Application to the Planar Magnetron.—L. Gold. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 683–690.) Analysis is restricted to electron energies of moderate relativistic values such that radiation loss is negligible. The cut-off voltage is found to vary linearly with the product of electrode separation L and magnetic field H, rather than quadratically as in the nonrelativistic case. The quasi-cycloidal period is found to depend on the voltage. The main formulae derived are listed.

621.385.029.63/.64 : 621.396.822 : 621.372.2 **3402**

A Minimum Noise Figure for the Traveling-Wave Tube.—S. Bloom & R. W. Peter. (*RCA Rev.*, June 1954, Vol. 15, No. 2, pp. 252–267.) A general expression is derived for the minimum obtainable noise figure, making use of the transmission-line-analogue theory previously developed (2810 of September) and assuming arbitrary values of space charge and helix loss. Design formulae are presented for realizing this minimum figure. Impedance diagrams commonly used in transmission-line problems can be adapted to simplify the design of an optimum impedance transformation along the beam in a low-noise gun.

621.385.029.64 : [621.376.22 + 621.376.32 **3403**

723 A/B Reflex Klystron Performance.—Zito. (See 3180.)

621.385.032 **3404**

Ceramic Tube Mount for Automatic Assembly.—R. N. Palmer. (*Electronics*, Aug. 1954, Vol. 27, No. 8, pp. 162–165.) Details are shown of a construction for receiving valves in which mica insulators are eliminated. Elements are stacked on two vertical pins and located by ceramic spacers, and the assembly is mounted on a flat ceramic stem and enclosed in a ceramic or glass envelope. Frame grids are used. For another account see *Tele-Tech*, Aug. 1954, Vol. 13, No. 8, pp. 69, 156–157.

621.385.032.213.2 **3405**

New Method of Measuring the Cathode Temperature of Indirectly Heated Vacuum Tubes.—S. Ikehara. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 725–732.) A method is described which makes use of the high harmonic component present in the initial current flowing to the anode, with alternating voltage applied to the anode. The method is rapid and reliable and gives a direct temperature reading. Results for diode, triode and pentode valves are compared with values obtained by other methods.

621.385.032.216 **3406**

Reactions between Oxide Cathodes and Gases at Very Low Pressures.—S. Wagener. (*Proc. phys. Soc.*, 1st May 1954, Vol. 67, No. 413B, pp. 369–386.) The experimental tube used has a lower tetrode part and an upper ionization-gauge part which is operated by space-charge-limited emission, the gauge thus indicating the pressure directly in front of the cathode. The thermionic emissivity is simultaneously measured by drawing a pulsed emission current from the cathode. The gases investigated were O_2, CO_2, CO, N_2, water vapour, H_2 and CH_4, over the pressure range 10^{-7}–10^{-5} mm Hg. Poisoning of emission by O_2 increases with increasing pressure and decreases with rise in temperature. It is independent of core material, and seems to be due to neutral particles and not to ions. From the rate of flow of O_2 into the cathode the quantity of Ba consumed during poisoning is estimated as of the order of 0·01 mol %. After exposure to O_2 cathode recovery is complete for temperatures between 1 000° and 1 100°K but not

for those above 1 200°K. At pressures below 5×10^{-6} mm Hg poisoning by CO_2 is more pronounced for cathodes with Pt cores. CO poisons cathodes with Ni cores, but activates those with Pt cores. N_2 does not affect emission appreciably; water vapour, H_2 and CH_4 activate at pressures below 10^{-5} mm Hg. The existence of a critical pressure for activation by CH_4 was demonstrated.

621.385.032.216 **3407**

Oxide Cathodes in Accelerating Fields.—P. N. Daykin & D. A. Wright. (*Proc. phys. Soc.*, 1st May 1954, Vol. 67, No. 413B, pp. 439–441.) In the theoretical treatment of emission in an accelerating field [2662 of 1952 (Wright & Woods)] equation (2) is not accurate and a limit is thus imposed on values of J/σ for which the given solution is satisfactory. A more general treatment by Shindo [2082 of 1952 and 591 of February] is recommended. See also 3094 of October (Shindo).

621.385.032.216 **3408**

Some Measurements of the Electrical Conductivity, Thermoelectric Power and Other Properties of the Coating in the Oxide-Coated Cathode.—C. M. Lovett. (*Proc. phys. Soc.*, 1st May 1954, Vol. 67, No. 413B, pp. 387–394.) Measurements of the conductivity of cathodes coated with Ba-Sr oxide were carried out under carefully controlled conditions over the temperature range 700°–900°K. Results showed that only one work function exists. This was confirmed by thermoelectric-power measurements.

621.385.032.216 **3409**

On the Conductivity of Oxide Cathode Coatings.—T. B. Tomlinson. (*J. appl. Phys.*, June 1954, Vol. 25, No. 6, pp. 720–724.) Conduction through the oxide coating was investigated experimentally by measuring the resistance between the cathode core and a helical metal probe embedded in the coating. I/V characteristics of diodes with such probes, for temperatures above 700°K, are generally linear at high positive and negative potentials but curved at lower potentials. A modified form of the Loosjes-Vink two-mechanism conduction theory (3208 of 1950) is presented which fits the experimental results and according to which the system can be represented by an equivalent circuit comprising a diode with a series resistance all in parallel with a larger resistance.

621.385.032.24.002.2 **3410**

An Electron-Tube Frame Grid Adaptable to Automatic Production.—R. E. Booth & R. C. White. (*Sylvania Technologist*, April 1954, Vol. 7, No. 2, pp. 58–60.) The dimensions of the grid described can be controlled with great accuracy because the lateral wires are brazed to the frame. The construction is rugged, and wire diameters as low as 0·00034 in. have been used successfully.

621.385.032.44 : 621.397.62 **3411**

Series Heater Strings for TV Receivers.—Roberts. (See 3374.)

621.385.2/.3 : 621.396.822 **3412**

Tube Noise under Large-Transit-Time Conditions.—S. V. Yadavalli. (*J. appl. Phys.*, May 1954, Vol. 25, No. 5, pp. 564–568.) The influence of transit time on shot noise in diodes is studied by the Rack-Llewellyn-Peterson method [2578 of 1944 (Llewellyn & Peterson)]; the results are applicable to triodes under certain conditions. Comparison of theoretical and experimental results indicates that under small-signal conditions the thermal distribution of electron velocities can safely be neglected.

621.385.3 **3413**

The Amplification Factor of a Triode: Part 3 — Supplement.—M. Wada. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser.B*, June 1953, Vol. 5, No. 1, pp. 87–95.) Simplified equations for calculating the amplification factor of planar and cylindrical triodes and corrections to previous parts (552 and 3607 of 1952) are given.

621.385.3/.4 : 621.396.822 **3414**

The Limiting Sensitivity of Amplifier Valves: Part 3 — Equivalent Noise Conductance and Noise Figure.—H. Rothe. (*Arch. elekt. Übertragung*, May 1954, Vol. 8, No. 5, pp. 201–212.) Theory given in the preceding papers is summarized, and modified nomenclature is introduced. From the general expression for the equivalent noise current at the grid an equivalent noise conductance is derived; this is a characteristic parameter which can easily be determined experimentally. From this noise conductance, together with the usual noise resistance and the input conductance of the valve and the parameters of the input circuit, the properties of the amplifier stage can be determined as regards both circuit operation and noise. An examination is made of the correlation between noise entering from the anode and that from the grid, and the dependence of the noise power on this correlation is discussed. The behaviour, in respect of matching and noise factor, of a valve with given parameters in an input stage is investigated. Part 2 : 1538 of 1953 (Rothe & Willwacher).

621.385.3/.4].002 **3415**

Mechanical Problems of Electron Tubes for L3 Carrier.—E. J. Walsh. (*Bell Lab. Rec.*, May 1954, Vol. 32, No. 5, pp. 183–187.) Details of construction and manufacture of valves Type 435A, 436A and 437A [1165 of 1952 (Ford & Walsh)], including an outline of optical techniques for checking grid-wire tension and mica insulators.

621.385.3/.4].029.62 **3416**

Radiation-Cooled Transmitting Triodes and Tetrodes for High Frequencies.—R. Hübner. (*Brown Boveri Rev.*, Nov./Dec. 1953, Vol. 40, Nos. 11/12, pp. 495–501.) Discussion of construction and applications of triodes T130-1 and T350-1 and tetrodes Q160-1 and Q400-1 for outputs up to 1 kW and frequencies up to 220 Mc/s.

621.385.5 : 621.397.62 **3417**

Valves for use in Band III Television Tuners.—L. Hampson & P. D. Neville. (*Mullard tech. Commun.*, May 1954, Vol. 1, No. 7, pp. 161–172.) The characteristics are described of the Type-PCC84 double-triode and Type-PCF80 triode-pentode valves which have been designed for use in the front-end stages of television receivers working on either Band I or Band III. Both are in the B9A all-glass miniature range. Performance in a practical circuit is discussed.

621.385.832 **3418**

The Metrechon — A Halftone-Picture Storage Tube.—L. Pensak. (*RCA Rev.*, June 1954, Vol. 15, No. 2, pp. 145–162.) The composite target of this tube comprises a fine metal mesh in contact with a thin sheet of insulator; it is scanned on one side by a high-velocity writing beam and on the other side by a low-velocity reading beam. The collector surrounds the reading gun. Four modes of operation corresponding to different ranges of target-mesh potential are discussed. The stored pattern can be read thousands of times without deterioration. The tube was developed primarily for processing radar p.p.i. patterns; other possible applications are mentioned.

621.385.832 **3419**

Skiatrons.—K. H. J. Rottgardt. (*Fernmeldetech. Z.*, May 1954, Vol. 7, No. 5, pp. 249–253.) A brief account

is given of the operation and construction of several skiatron-type tubes developed during the War in Great Britain, the U.S.A. and Germany. A tube is also described in which the screen is observed from the same side as the incident electron beam and the illumination; higher picture-contrast is claimed for this type of construction.

621.385.832 : 535.37 **3420**

Destruction of Luminescence of Cathode-Ray-Tube Screens by Electrons.—K. H. J. Rottgardt. (*Z. angew. Phys.*, April 1954, Vol. 6, No. 4, pp. 160–163.) The decrease in luminescence due to electron bombardment, investigated for Zn_2SiO_4 : Mn, ZnS : Ag, and CdS : Cu screens, shows a marked dependence on vacuum conditions. In CdS : Cu screens having a uniform particle size, the degree of electron burn depends on the number of incident electrons and is independent of the beam current and anode voltage up to 4 kV. Electron and ion burns can be removed by heating at 400°C for half an hour and restoring the tube vacuum. It is suggested that lattice defects are produced by ionization by the bombarding electrons; these defects constitute deep traps in the band structure of crystal phosphors via which radiationless transitions may take place.

621.385.832 : 537.56 **3421**

The Negative-Ion Components of the Electron Beam in Cathode-Ray Tubes, particularly Television Tubes.—W. F. Niklas. (*Philips Res. Rep.*, April 1954, Vol. 9, No. 2, pp. 122–130. In German.) The source and the nature of the negative-ion component were found by means of a mass-spectrometer-type method. The cathode ions were identified as Cl^{35}, Cl^{37} and CN or C_2H_2; the ions produced in the gas between the grid and first anode were O, CH and C. A reduction in the residual gas pressure resulted in the elimination of the latter group; the occurrence of CN (or C_2H_2) ions decreased with time. An account of the experimental method is given.

621.387 **3422**

Effects of Ambient-Temperature Variations on Glow-Discharge Tube Characteristics.—F. A. Benson & G. Mayo. (*J. sci. Instrum.*, April 1954, Vol. 31, No. 4, pp. 118–120.) Measurements on ten different types of tube are reported; typical temperature/running-voltage curves are shown. Large variations in the shapes of the characteristics may occur in tubes of a given type, and the gas filling seems to be an important factor in determining the sign of the temperature coefficient. Some tubes exhibit a change of sign of temperature coefficient.

621.387 : 621.318.572 **3423**

Measurements of the Gas Temperature of a Low-Pressure R. F. Discharge.—I. Reingold & K. Garoff. (*J. appl. Phys.*, April 1954, Vol. 25, No. 4, pp. 537–540.) Measurements were made of the temperature of ionized gases at low pressure in a.t.r. cavities having windows of different Q values, the discharge being initiated by a high-power pulse at 2·82 kMc/s. N_2, H_2, Ar, and Ar and water vapour were studied. From the point of view of heat dissipation, Ar is the most effective filling and, of the single-iris windows, those with higher Q give the better performance at high power levels. A double-iris window combining good mechanical strength with reasonably low Q can operate at higher power levels and dissipate more heat than comparable cavities with single-iris windows.

621.387.032.5 **3424**

Gas Tube Filament Connections.—M. Brenner & H. G. Schmitt. (*Trans. Amer. Inst. elect. Engrs*, 1953, Vol. 72, Part I, *Communication and Electronics*, pp. 776–784. Discussion, pp. 784–785.) Measurements indicate that the flexible lead connection is preferable to the pin-and-socket connection from the point of view of cool running.

621.314.63 + 621.314.7 **3425**

Kristalloden-Technik. [Book Review]—R. Rost. Publishers: W. Ernest & Sohn, Berlin, 1954, 185 pp., DM 13.50. (*Arch. elekt. Übertragung*, April 1954, Vol. 8, No. 4, p. 154.) Describes the preparation, characteristics, methods of testing and applications of crystal diodes and transistors.

MISCELLANEOUS

061.4 : 621.3 **3426**

French Components Show, 1954.—E. Aisberg. (*Wireless World*, June 1954, Vol. 60, No. 6, pp. 287–289.) Main trends at the Salon de la Pièce Détachée are outlined. For more detailed accounts in French, see *TSF et TV*, April–June 1954, Vol. 30, Nos. 306–308, pp. 154–159, 187–192 & 221–228; *Télévision*, May 1954, No. 43, pp. 132–136; *Rev. Son*, April 1954, No. 13, pp. 114–116.)

061.4 : 621.39 **3427**

Report of the German Industries Fair, Hanover.—(*Funk-Technik, Berlin*, May 1954, Vol. 9, No. 10, pp. 262–267.) Radio and television receivers, u.s.w. and television aerials, and interference-suppression arrangements shown at the 1954 exhibition are described. See also *Z. Ver. dtsch. Ing.*, 1st July 1954, Vol. 96, No. 19, pp. 631–638.

621.3.012 **3428**

New Electronic Drafting Tools and Techniques.—J. R. McDermott. (*Electronics*, Aug. 1954, Vol. 27, No. 8, pp. 121–125.) Aids described for preparing circuit and wiring diagrams include rubber stamps, stencils, pre-prepared lettering on adhesives, etc.

621.39.001.891 **3429**

Facilities for Experimental Work in the Engineering Department.—W. West. (*P.O. elect. Engrs' J.*, April 1954, Vol. 47, Part 1, pp. 10–14.) Brief accounts of the research and development work undertaken in the various branches of the Engineering Department of the British Post Office, particularly in the communications field. The work at the main research station at Dollis Hill was described earlier [e.g. 1486 of 1952].

621.39.001.891 : 538.56.029.6 **3430**

Centre for the Study of Microwave Physics [Florence]**. Activities during the Year 1952 in Collaboration with the Military Geographical Institute.**—N. Carrara. (*Ricerca sci.*, May 1954, Vol. 24, No. 5, pp. 987–991.) The subjects studied included the use of radar for geodesy and for investigating atmospheric precipitation, the propagation of e.m. waves through fogs, and the design of v.h.f. transmitter-receivers.

621.396.6 **3431**

Soviet Radio Equipment at the Foire de Lyon.—(*TSF et TV*, June 1954, Vol. 30, No. 308, pp. 217–218.) Radio and television receivers, measuring instruments, aerials, etc., were among the equipment on show at the 1954 exhibition.

621.396.6.002.2 **3432**

Manufacturing Cost Determination of an Automatic Electronic Factory.—(*Tech. News Bull. nat. Bur. Stand.*, May 1954, Vol. 38, No. 5, pp. 77–79.) Report of an analysis indicating the manufacturing economies consequent on the use of modular design and mechanized production [693 of March (Henry & Rayburn)].

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.213 : 538.65 **3433**

Magnetic Dispersion of Longitudinal Sound Oscillations.—L. L. Myasnikov & G. K. Ul'yanov. (*C. R. Acad. Sci. U.R.S.S.*, 1st June 1954, Vol. 96, No. 4, pp. 729–731. In Russian.) The dispersion of sound and the logarithmic decrement of oscillations were determined experimentally in a rectangular Al plate of dimensions $131{\cdot}5 \times 7{\cdot}5 \times 1{\cdot}8$ mm, at a frequency of 18·5 kc/s, a magnetic field being applied in a direction perpendicular to the longitudinal oscillations. The resonance frequency rose by 1·5 c/s on applying a field of $12{\cdot}8 \times 10^3$ gauss, the decrement increased by 15%. Using a specimen of thickness 1 mm, the dispersion increased to 3 c/s, the decrement by 30%.

534.213 : 538.65 **3434**

Magnetoacoustic Effect in Paramagnetic and Diamagnetic Metals.—L. L. Myasnikov & G. K. Ul'yanov. (*C. R. Acad. Sci. U.R.S.S.*, 11th June 1954, Vol. 96, No. 5, pp. 967–969. In Russian.) Previously reported work on the magnetic dispersion of sound in Al (3433 above) is extended to include Mg and Cu. Results indicate that the magnetoacoustic effect in torsionally vibrating plates is produced by heating currents which cause changes in the effective acoustic impedance. An increase in the resistive component of the impedance results in an increase in damping, an increase in the reactive component in an increase in phase velocity.

534.231.3 **3435**

Acoustic Impedance of a Moving Plane Emitter.—D. N. Chetaev. (*C. R. Acad. Sci. U.R.S.S.*, 21st May 1953, Vol. 90, No. 3, pp. 355–358. In Russian.) Expressions are derived for the resistive and reactive components of the impedance of a plane plate in an infinite rigid wall whose position is given by $z=0$, vibrating according to $\dot{z} = v \exp(i\omega t)$ and radiating into the semi-space $z>0$ which is filled with a perfectly compressible fluid moving in the direction of the y axis with a velocity V smaller than the velocity of sound u. The values of the resistance and the reactance are tabulated for the particular case of a square plate for values of ka ranging from 1 to 10, where $k = \omega/u$ and a is a function of the linear dimensions of the plate, for $V/u = 0{\cdot}1$.

534.232 : 621.395.623.8 **3436**

Sound Radiation from the Zonal Radiators.—T. Nimura & Y. Watanabe. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, Dec. 1953/March 1954, Vol. 5, Nos. 3/4, pp. 155–195.) Radiators analysed are (*a*) infinitely long cylinders, (*b*) prolate spheroids, (*c*) sphere, and (*d*) oblate spheroids. Expressions are obtained, and results are shown graphically, for the sound pressure, the directivity and the radiation impedance.

534.32 : 621.372.5 **3437**

Use of Integrator and Differentiator Circuits in Acoustics Technique.—A. Foch, J. Rateau & R. Counord. (*C. R. Acad. Sci., Paris*, 18th Aug. 1954, Vol. 239, No. 7, pp. 528–529.) Preliminary note indicating modifications of vocal or instrumental sounds that can be produced by including integrators or differentiators in the reproducing circuits. The reversibility of the effects was confirmed by an experiment in which a voice was easily recognizable after two successive differentiations followed by two integrations.

534.321.9 : 534.22 **3438**

Application of the Pulse Method to Measurement of the Velocity of Ultrasonic Waves.—E. I. Chuikin. (*Zh. tekh. Fiz.*, June 1954, Vol. 24, No. 6, pp. 1125–1135.) Errors due to the distortion of the acoustic pulse at the boundary of media with different acoustic impedances were calculated and the results were confirmed experimentally by measurements of the velocity of ultrasonic waves at 1 and 4·9 Mc/s in polyethylene.

534.614.082.5 **3439**

Apparatus to Measure the Velocity of Sound Down to Liquid Helium Temperatures with the Optical Method.—A. van Itterbeek, G. J. van den Berg & W. Limburg. (*Physica*, May 1954, Vol. 20, No. 5, pp. 307–310.)

534.78 : 621.317.755 **3440**

Visible-Speech Rotary-Field Coordinate-Conversion Analyser.—F. Vilbig. (*Trans. Inst. Radio Engrs*, May/June 1954, Vol. AU-2, No. 3, pp. 76–80.) C.r.o.

apparatus is described for displaying patterns corresponding to sounds, the signals being applied to the two pairs of plates with the same amplitude and a 90° phase difference so as to produce a polar-coordinate pattern. An optical arrangement comprising a rotating slotted disk and an independently rotating prism is used to transform this into a cartesian-coordinate pattern, thereby facilitating the investigation of certain sounds.

534.8 : 621.396.712.2/.3 **3441**

The Acoustical Design of a New Sound Broadcasting Studio for General Purposes.—H. R. Humphreys. (*B.B.C. Quart.*, Summer 1954, Vol. 9, No. 2, pp. 102–110.) Illustrated description of the B.B.C. studio LH.1. The area, of about 650 ft², is divided into acoustically live and dead parts by a folding partition of height 8 ft faced on the one side with plywood and on the other with absorbent material; the partition is continued to the full height of the studio (16 ft) in the form of suitably treated double curtains. Reverberation/frequency characteristics obtained during construction and in the final state are shown.

534.84 **3442**

Simplified Methods for the Measurement of the Acoustic Parameters of Rooms.—G. Kurtze. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st June 1954, Vol. 32, No. 6, pp. 218–222. In German.) Equipment is described for measuring irregularities of the sound-pressure/frequency characteristic at a fixed point, and the directional diffusion [311 of February (Thiele)]. Electrical-circuit methods are used to reduce the labour involved in evaluating the measurements.

534.845 : 518.3 **3443**

A Nomogram for the Simplified Determination of the Coefficient of Sound Absorption by the Reverberation-Chamber Method.—W. Händler & G. Venzke. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1954, Vol. 6, Nos. 3/4, pp. 84–87.)

621.395.616 **3444**

Condenser Microphone Type MR-103.—T. Hayasaka, K. Masuzawa & M. Suzuki. (*Rep. elect. Commun. Lab., Japan*, Feb. 1954, Vol. 2, No. 2, pp. 1–5.) The microphone, 24 mm in diameter and 21 mm in length, is constructed entirely of titanium apart from an insulator of optical glass. The diaphragm is 0·009–0·017 mm thick and 0·02 mm from the back electrode, which is perforated and slotted for free passage of air. Operating characteristics shown compare favourably with those of a Western Electric Type 640-AA.

621.395.623.7.001.4 **3445**

Standardizing L.S. Measurements.—(*Wireless World*, Oct. 1954, Vol. 60, No. 10, pp. 493–494.) A note on British Standard 2498 : 1954.

621.395.625.2 **3446**

New Pickup Arm.—(*Wireless World*, Oct. 1954, Vol.60, No. 10, p. 495.) In a design for reducing tracking errors with the usual lateral-cut disk, two arms of different lengths are linked so as to keep the pickup head aligned very closely along the ideal tangential direction at all radial distances.

621.395.625.3 **3447**

Distortion due to Mechanical Disturbances in Magnetic Sound-Recording Apparatus.—W. Guckenburg. (*Funk u. Ton*, June 1954, Vol. 8, No. 6, pp. 312–322.) Distortion due to nonuniform motion and transverse movements of the magnetic tape is discussed. The effect of various mechanical defects of the driving mechanism is considered theoretically and the permissible mechanical tolerances are deduced from considerations of the corresponding audible distortion at various frequencies and tape velocities. Amplitude distortion due to the use of differently positioned magnetic heads in recording and in reproduction is also discussed.

621.395.625.3 **3448**

Production of Gap in Magnet Systems for Recording and Reproduction of Magnetograms.—K. A. Egerer. (*Frequenz*, June 1954, Vol. 8, No. 6, pp. 180–182.) The manufacture and electrical characteristics of magnetic heads with accurately dimensioned diamagnetic gaps are considered. The gap materials investigated included Au, Ag, Cd, selenides, tellurides, Al_2O_3 and SiO_2. Electrolytic deposition of the diamagnetic material on the pole-pieces was found suitable in several cases.

621.395.625.3 : 621.385.832 **3449**

Magnetic-Tape Pickup has D.C. Response.—J. W. Gratian. (*Electronics*, Sept. 1954, Vol. 27, No. 9, pp. 156–159.) The low-frequency response of a reproducing head of the electron-tube beam-deflection type (1985 of July) is improved by using transverse rather than longitudinal magnetization. The construction of a suitable external core for the pickup tube is described. A system using both longitudinal and transverse recording is recommended for applications where good response is required at high audio frequencies as well as d.c.

AERIALS AND TRANSMISSION LINES

621.315.212 **3450**

Modern Coaxial-Cable Technique in Great Britain.—E. Baguley. (*Elect. Commun.*, June 1954, Vol. 31, No. 2, p. 152.) Correction to paper abstracted in 960 of April.

621.372 : 621.385.029.63/.64 **3451**

Coupling of Modes in Helixes.—J. R. Pierce & P. K. Tien. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1389–1396.) Propagation in helices is analysed as an effect of the coupling through spatial harmonics of the slow wave, which travels along the wire with a velocity about the same as that of light, to the fast waves, which travel along the axis with such a velocity. The results are in general agreement with those obtained by a method of analysis assuming the helix to be wound of infinitely thin conducting tape. Cases considered include the helix in free space, the helix surrounded by a conducting tube, and the bifilar helix. See also 1987 of July (Pierce).

621.372.2.015.3 **3452**

The Use of Thévenin's Equivalent Circuit to determine the Conditions at the Termination of a Lossless Transmission Line on Arrival of a Surge.—G. C. Dewsnap. (*Aust. J. appl. Sci.*, June 1954, Vol. 5, No. 2, pp. 132–140.) Two equivalent circuits are discussed, the one appropriate when the pulse is rectangular and the line termination resistive, the other when the pulse is nonrectangular and the termination includes reactance.

621.372.21 : 621.315.213 **3453**

Machine Methods make Strip Transmission Line.—K. S. Packard. (*Electronics*, Sept. 1954, Vol. 27, No. 9, pp. 148–150.) A microstrip transmission line of the type comprising a conducting strip between two ground planes [621 of 1953 (Grieg & Engelmann)] has the conducting strip split into an upper and a lower half with a dielectric support between them. The two halves are connected together at input and output so that they are at the same potential. This construction gives a

high Q, such as is desirable in filters and resonators. Dimensions must be kept below indicated limits in order to eliminate propagation of higher modes. Operation at frequencies up to 10 kMc/s has been achieved; there is no low-frequency limit, except that the length of resonant elements becomes impracticable below about 100 Mc/s.

621.372.8 **3454**

A Contribution to the Theory of Right-Angled Junctions in Waveguides.—J. D. Pearson. (*Quart. J. Mech. appl. Math.*, June 1954, Vol. 7, Part 2, pp. 194–202.) "The propagation of waves through a junction of two rectangular waveguides at right angles is considered for the case when the dimensions of one of the guides are such as to allow the propagation of more than one mode. Numerical results are given when one guide is of square cross-section."

621.372.8 **3455**

A Method of Broadbanding Waveguide Windows.—H. G. Hereward & M. G. N. Hine. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1450–1451.) Increased bandwidth is obtained by providing series as well as shunt inductance. A v.s.w.r. less than 1·02 is theoretically obtainable over a frequency band of $\pm 20\%$ at a wavelength of about 10 cm with an arrangement using a silica window with inductive irises and inductive slots on both sides. Such a window has been used to pass up to about 15 MW peak power.

621.372.8 **3456**

A Simple Graphical Analysis of a Two-Port Waveguide Junction.—L. B. Felsen & A. A. Oliner: J. E. Storer, L. S. Sheingold & S. Stein. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1447–1448.) Comment on 3191 of 1953, authors' reply, and further comment.

621.372.8 **3457**

Waveguides with Nonhomogeneous Dielectric.—D. Graffi. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1449–1450.) A summary is given of papers by several authors, published in Italy, giving analysis for waveguides having perfectly conducting walls and enclosing dielectrics with nonuniform permittivity.

621.372.8 : 621.315.6 **3458**

Dielectric Tubes as Waveguides.—H. G. Unger. (*Arch. elekt. Übertragung*, June 1954, Vol. 8, No. 6, pp. 241–252.) With dielectric rods, the frequency band over which the attenuation of surface waves is reasonably low is not wide enough for practical communication purposes. A theoretical study is made of the possibility of obtaining a larger bandwidth by using dielectric tubes. The propagation constants of the natural H_{0l}, E_{0l} and HE_{1l} modes are derived; the H_{1l} is most suitable for use as principal mode in the low-loss transmission of centimetre waves. Applications as aerials and flexible lines are indicated; a metal funnel is used to excite the dielectric tube.

621.396.67 **3459**

On Minimum Range for Radiation Patterns.—D. R. Rhodes. (*Proc. Inst. Radio Engrs*. Sept. 1954, Vol. 42, No. 9, pp. 1408–1410.) It is shown that at distances equal to or greater than $2D^2/\lambda$, where D is the greatest transyerse dimension of the aerial, the phase variation over D is $<\pi/8$ and the amplitude variation is $< 10\%$ when the dimensions of the illuminating aperture are $<D$. The pattern of a uniform line aerial illuminated by a paraboloid of such dimensions is essentially the same as with a point source of illumination. For back-scattering measurements the minimum range is $4D^2/\lambda$.

621.396.67 : 621.397.61 **3460**

The Impedance Specification of a Television Transmitting Aerial.—H. Page. (*B.B.C. Quart.*, Summer 1954, Vol. 9, No. 2, pp. 123–128.) Until recently, the B.B.C. specified for television transmitting aerials a s.w.r. better than 0·95 over the working frequency band when connected to the transmission line. Experiments made at the Sutton Coldfield station [854 of 1952 (Bevan & Page)] indicated that some relaxation of this specification was permissible. An account is given of tests made to determine the shape of the reflection-coefficient/frequency characteristic permitting the greatest relaxation consistent with maintaining at an imperceptible level the signal delayed by reflection at the aerial and again at the transmitter. To avoid instrumental complication, the tests were made using a video-frequency analogue of a d.s.b. system; the results are applicable to the vestigial-sideband system actually used. The tests were subjective, and involved twenty experienced viewers. The permissible level of the delayed image is found to be 2–4 db less for the anti-phase than for the in-phase condition. Of three types of distorting network tried, giving 'top-lift', 'top-cut' and 'middle-lift' characteristics respectively, the first permits greatest relaxation of aerial performance.

621.396.67 : 621.397.62 **3461**

Receiving Aerials for Television (Band III).—E. Divoire, P. Hontoy & L. Bosman. (*Rev. HF, Brussels*, 1954, Vol. 2, No. 11, pp. 299–310.) Gain, bandwidth and coupling systems of dipole arrays for the v.h.f. band are discussed. Measurements made on an experimental model and on two stacked arrays made commercially in Belgium are reported. The measured gain of the latter types was below the rated value; the importance of a suitable coaxial coupling and balancing system is stressed.

621.396.67.091.2 **3462**

'Working Gain' of an Antenna Connected with a Feeder.—S. Uda & Y. Mushiake. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, Dec. 1953/March 1954, Vol. 5, Nos. 3/4, pp. 197–202.) The receiving-aerial working gain is defined as the ratio of (power transmitted via the feeder to the load) to (power transmitted via a matching section to a similar load of an ideal dipole). An analogous definition is given for transmitting aerials. The working gain is approximately equal to the aerial gain less the matching and feeder losses.

621.396.674.3 : 621.396.677.3 **3463**

Some Considerations on Matching Devices for a Doublet Antenna.—S. Uda & Y. Mushiake. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, Sept. 1953, Vol. 5, No. 2, pp. 95–114.) The T-match (or Π-match) aerial, which consists of centre-earthed approximately-half-wave elements, was described by B. Mayson in *Wireless World*, Oct. 1951, Vol. 57, No. 10, pp. 404–406. Theory is developed and the results are extended to the analysis and design of a double-H-type aerial. In particular the effect of finite conductor thickness is taken into account. Graphs of the input-impedance/element-dimensions characteristics and numerical examples of aerial design are given.

621.396.674.37.029.62 **3464**

An U.S.W. Wide-band Aerial for High Power and High Gain.—H. Körner & K. H. Kristkoiz. (*Frequenz*, June 1954, Vol. 8, No. 6, pp. 169–176.) Aerial systems for the 87–100-Mc/s band are considered consisting of radiating elements forming the sides of squares several of which are stacked on a single vertical mast. Two bent full-wave aerials or four half-wave aerials are used to form the square. Polar diagrams, impedance/frequency

characteristics and photographs of typical aerial systems are given. The coupling with aerials of other services mounted on the same mast is discussed and a nomogram and formulae for calculating the coupling are given.

621.396.677.029.6 : 621.396.932.1 **3465**

U.S.W. D.F. Aerials.—A. Köhler. (*Funk u. Ton*, June 1954, Vol. 8, No. 6, pp. 295–302.) The characteristics are given of an aerial system consisting of pairs of double-V wide-band dipoles and reflectors mounted at an angle to the vertical at the diagonally opposite corners of a rectangular frame. The u.s.w. frequency band is covered by three such systems with frequency ranges 40–80, 80–160 and 160–300 Mc/s. Bearing errors, system bandwidth and aerial coupling are discussed.

621.396.677.32 **3466**

Amplitude-Phase Correlation of Currents in the Elements of the 'Wave-Channel' Aerial.—D. M. Vysokovski. (*C. R. Acad. Sci. U.R.S.S.*, 11th June 1954, Vol. 96, No. 5, pp. 971–974. In Russian.) Aerial systems consisting of a dipole and several director elements are considered. For a system with five directors, the amplitudes of currents in the elements (including the directly fed dipole) and the phase differences between currents in adjacent elements are tabulated for values of the ratio element-length/λ from 0·40 to 0·46. The field strengths in the forward and backward directions are also given. The use of resultant amplitude and phase values, related to average values, in field-strength gain estimation and other calculations is illustrated. See also 2901 of 1953.

621.396.677.7/.8 : 621.396.41 **3467**

Dual-Mode Horn Feed for Microwave Multiplexing.—D. J. LeVine & W. Sichak. (*Electronics*, Sept. 1954, Vol. 27, No. 9, pp. 162–164.) The ability of a waveguide to propagate orthogonally polarized waves independently of each other is used in an aerial for a two-channel system. Probes carrying the two signals are arranged at right angles in a square-waveguide horn which illuminates a parabolic reflector, various possible arrangements being indicated. Decoupling of 50 db or more between the two signals can be attained.

621.396.677.71 **3468**

Application of Mathieu Functions in computing the Field Distribution of an Aerial for a given Directional Characteristic.—A. A. Pistol'kors. (*C. R. Acad. Sci. U.R.S.S.*, 11th April 1953, Vol. 89, No. 5, pp. 849–852. In Russian.) The field due to radiation from an infinitely long slot in a perfectly conducting infinite plane screen is considered; if the directional characteristic is expressed by a Fourier series the corresponding required field distribution at the slot can be calculated. Field distributions in slots of widths 0·637 λ and 1·27 λ required to produce a directional characteristic $f(\eta) = \sin(\pi \cos \eta)/\sin \eta$ are calculated numerically and the results are shown graphically. The mathematical conditions for exact and for approximate solutions are stated.

621.396.677.73.012.12 **3469**

A Method of Calculating Directivity of Antenna with Proper Aperture Illumination.—S. Kawazu. (*Rep. elect. Commun. Lab., Japan*, April 1954, Vol. 2, No. 4, pp. 18–21.) Digest of paper published in *Monthly J. elect. Commun. Lab., Japan*, 1954, Vol. 7, No. 1. The directivity is expressed as the sum of a complex series of terms which are the product of coefficients related to the Fourier series coefficients of the expression for the aperture illumination and of functions of direction and aperture size. The latter functions are shown graphically and are also tabulated. Results of calculations of the directivity of a horn with rectangular aperture, excited by TE waves, are shown graphically for various phase distributions over the aperture.

621.396.677.832 **3470**

On the Theory of an Antenna with an Infinite Corner Reflector.—J. R. Wait. (*Canad. J. Phys.*, June 1954, Vol. 32, No. 6, pp. 365–371.) A straightforward solution is obtained for the resultant field anywhere within the V angle, for the case of a dipole radiator. The result is discussed and compared with that obtained by Moullin (3291 of 1945) for a line source.

621.396.677.85 **3471**

Path-Length Lens Antenna.—H. Takeuchi, S. Kawazu, H. Wada, B. Oguchi & K. Ohashi. (*Rep. elect. Commun. Lab., Japan*, Nov. 1953, Vol. 1, No. 3, pp. 48–54.) Details are given of the design and performance of two lens aerials [3058 of 1949 (Kock)] constructed in 1952 for a multichannel relay system and operating in the frequency band 3·7–4·2 kMc/s with gain $>$ 40 db.

621.396.677.85 **3472**

Modified Luneberg Lens.—A. S. Gutman. (*J. appl. Phys.*, July 1954, Vol. 25, No. 7, pp. 855–859.) Design theory based on Hamiltonian optics is developed for a large-aperture microwave aerial giving a pencil beam which can be scanned without restriction by moving a point source over a spherical surface of relatively small diameter. An experimental aerial using a cylindrical lens and operating in the TE_{10} mode is described.

AUTOMATIC COMPUTERS

681.142 **3473**

LEO (Lyons Electronic Office).—J. M. M. Pinkerton, E. J. Kaye, E. H. Lenaerts & G. R. Gibbs. (*Electronic Engng*, July–Sept. 1954, Vol. 26, Nos. 317–319, pp. 284–291, 335–341 & 386–392.) A detailed account of the installation, the nucleus of which is a digital computer developed from the EDSAC. Operation, maintenance and fault-finding procedure are described. An extensive system of marginal checking has been included. Punched tape, read photoelectrically, is used for the input; errors in perforation are completely eliminated by use of a special checking device.

681.142 **3474**

Amplitude Comparator for Computing Purposes.—T. Z. Aleksić. (*Bull. Inst. nuclear Sci., Belgrade*, June 1954, Vol. 4, No. 50, pp. 13–19. In English.) A simple circuit is described which gives uniform output pulses for a large range of input-signal derivatives. Low transformer output impedance is provided. Measures are indicated for ensuring stability when the signals are slowly varying.

681.142 **3475**

Some Applications of Elements with Discontinuous Operation in Analogue Computation.—D. M. Mitrović. (*Bull. Inst. nuclear Sci., Belgrade*, June 1954, Vol. 4, No. 50, pp. 1–11. In French.) Development of work noted in 858 of March. The field of application of the differential analyser is enlarged by incorporating amplitude comparators and electronic switches. Solution of particular differential equations is discussed.

681.142 **3476**

Multiplier for Analog Computers.—C. J. Savant, Jr, & R. C. Howard. (*Electronics*, Sept. 1954, Vol. 27, No. 9, pp. 144–147.) Multiplication is performed by addition of logarithms, using the linear-to-logarithmic

converter described previously [3042 of 1953 (Howard et al.)] followed by a logarithmic-to-linear converter. Application to solution of nonlinear differential equations is described.

681.142 : 629.13 **3477**

Analogue Computers in Aircrew Training Apparatus.—A. E. Cutler. (*J. Brit. Instn Radio Engrs*, Aug. 1954, Vol. 14, No. 8, pp. 351–360.) Comparison of the relative complexities of full-flight-simulator computers using digital and analogue methods indicates the analogue type to be more suitable. Operation and performance are discussed.

CIRCUITS AND CIRCUIT ELEMENTS

621.314.2.029.63 : 621.372.51 **3478**

Construction and Calibration of a Very-High-Frequency Transformer.—H. Paucksch, H. Schneider & H. Schneiders. (*Fernmeldetech. Z.*, June 1954, Vol. 7, No. 6, pp. 281–284.) A matching device for insertion in a coaxial line consists of a pair of rings which can be slid independently along the line between the inner and outer conductors without touching either of them. The frequency range for the type described is 1–3 kMc/s. Theory is developed on the basis of the equivalence of the device to a cascade connection of two loss-free quadripoles.

621.316.8 **3479**

Component Design Trends — Fixed Resistors show Stability Improvements.—F. Rockett. (*Electronics*, Sept. 1954, Vol. 27, No. 9, pp. 132–137.) A survey of available types; temperature, voltage and power limits are discussed. Composition resistors continue to be the most generally used. Developments in pyrolytic carbon film, printed, wire-wound and metal-film types are reported.

621.316.8.029.64 : 621.372.8 **3480**

Surface Resistors for Centimetre-Wave Technique.—H. Severin. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st June 1954, Vol. 32, No. 6, pp. 209–218. In German.) An account is given of the development of a method of manufacturing carbon-layer resistors for waveguide attenuators and nonreflecting terminations, using a colloidal suspension of graphite and an insulating base of pertinax. Consideration is given to the choice of medium (water or alcohol) and the method of application (painting, dipping or spraying); particular importance is attached to the uniformity of the layers. The resistance layer is protected by a coating of polystyrene. An instrument designed for measuring the d.c. resistance of the layers is described. Measurements at d.c. and at 3·7 kMc/s are reported.

621.316.86 : 537.312.6 **3481**

Theory of the Thermistor as an Electric Circuit Element. A Study of Thermistor Circuits.—S. Ekelöf & G. Kihlberg. (*Chalmers tek. Högsk. Handl.*, 1954, No. 142, 36 pp.) Fundamental relevant physical and mathematical concepts are presented; the dissipated power rather than the thermistor temperature is taken as the basic variable. The power-balance equation is presented in a form introducing the thermal time constant, and is used to develop equivalent circuits for thermopositive and thermonegative resistors permitting calculation of superposed variable states.

621.316.86 : 546.281.26 **3482**

Nonlinearity of the Volt-Ampere Characteristics of Silicon-Carbide Resistors.—N. P. Bogoroditski & Z. F. Vorobei. (*Zh. tekh. Fiz.*, May 1954, Vol. 24, No. 5, pp. 811–817.) Results of an experimental investigation of the conductivity and conductivity/voltage characteristics of SiC powders under a pressure of 600 kg/cm² show that as the field strength increases the conductivity becomes proportional to the square root of the field strength; this is probably due to an increase of the effective area of contact. Electron micrographs of typical SiC crystal surfaces are shown. Results obtained using crystals graded according to size are shown graphically and are discussed from the point of view of producing a resistor with the greatest possible nonlinearity.

621.318.015.4 **3483**

Fundamental Oscillations of Coils and Windings.—P. A. Abetti & F. J. Maginniss. (*Trans. Amer. Inst. elect. Engrs*, 1954, Vol. 73, pp. 1–10; Digest, *Elect. Engng, N.Y.*, June 1954, Vol. 73, No. 6, p. 530.) Analysis is given based on the solution of a Fredholm integral equation. Fundamental frequencies are evaluated for air-core and iron-core coils, and the voltage distribution is discussed. See also 655 of March.

621.318.5 : 621.318.435 **3484**

Saturable Transformers as Gates.—B. Moffat. (*Electronics*, Sept. 1954, Vol. 27, No. 9, pp. 174–176, 178.) Use of ferrite-cored units as switching elements is discussed; input and output windings are wrapped on each core and control windings are wrapped around both. Applications include magnetic-drum read-out systems for computers.

621.318.57 **3485**

Multistable Electronic Circuits and Decades.—R. Favre. (*Helv. phys. Acta*, 30th June 1954, Vol. 27, No. 3, pp. 235–240. In French.) The design of counter circuits is considered from the point of view of simplicity and reliability. From this point of view it is advantageous to keep the number of internal couplings as low as possible. Trigger chains are used with odd numbers of triode valves alternately blocked and conducting except for one adjacent pair in the same state. To ensure stability, damping is required at the critical frequency; circuit arrangements are shown for providing this in cases where the two adjacent valves in the same condition are (*a*) both blocked, (*b*) both conducting.

621.318.57 **3486**

A Sensitive Pulse Trigger Circuit with a Stable Threshold.—K. Kandiah. (*Proc. Instn elect. Engrs*, Part II, June 1954, Vol. 101, No. 81, pp. 239–247. Discussion, pp. 260–261.) A pulse-amplitude discriminator for positive or negative pulses is described in which the sensitivity is independent of contact-potential variations in the valves. With a threshold of 100 mV stability is within 2%. The simplified circuit comprises two triodes passing steady currents and a clamping diode operated under retarding-field conditions. The minimum effective pulse width is about the same as that for conventional discriminators. Performance figures substantiate theoretical calculations of sensitivity.

621.318.57 : 621.387 **3487**

A Scaling Unit employing Multi-electrode Cold-Cathode Tubes.—K. Kandiah. (*Proc. Instn elect. Engrs*, Part II, June 1954, Vol. 101, No. 81, pp. 227–238. Discussion, pp. 260–261.) A complete scaling unit for counting regular or random pulses is described. Different methods of driving cold-cathode scaling valves are considered. In the method used the amplitudes and durations of the pulses applied to all stages in the slow-scaling section are controlled by a common pulse generator. The unit comprises a pulse-amplitude discriminator of high sensitivity, a fast-scaling stage with a 4-element valve, a cascade arrangement of 3-element valves Type CV2271 with cold-cathode gating valves, and the pulse generator. Some routine tests for valve deterioration are outlined.

621.372 : 621.3.015.3 **3488**

Empirical Transient Formulae.—Z. E. Jaworski. (*Electronic Engng*, Sept. 1954, Vol. 26, No. 319, pp. 396–400.) Relations between the steady-state frequency response of a network and its transient response are derived in terms of shape parameters, the most important of which for the transient response are rise time, overshoot and relaxation time. Two classes of network are considered, (*a*) those with a flat-topped frequency response curve with a single peak at zero (centre) frequency, and (*b*) those whose frequency response curve exhibits two equal maxima located symmetrically about zero (centre) frequency. It is concluded that the network giving most faithful reproduction of a unit step has a trapezoidal frequency response curve, and that compromise is required in design as between ideal frequency response and ideal transient response.

621.372 : 621.3.016.35 **3489**

Nyquist's Criterion.—O. P. D. Cutteridge. (*Wireless Engr*, Oct. 1954, Vol. 31, No. 10, pp. 274–275.) "Nyquist's form of the stability criterion is deduced using well-known properties of complex numbers and without using integration in the complex plane. A new form of criterion—the 'minimum-phase criterion'—is also developed."

621.372.5 **3490**

A Note on the Transfer Voltage Ratio of Passive *RLC* Networks.—F. M. Reza & P. M. Lewis II. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, p. 1452.) Results obtained by Fialkow & Gerst (3369 of 1952) are generalized to include *RLC* networks.

621.372.5 **3491**

Symmetrical Quadripole Lattice Networks. Determination of Pass Bands and Attenuation Bands.—M. Cotte. (*J. Phys. Radium*, June 1954, Vol. 15, No. 6, pp. 494–495.) A graphical method of determining the bands is discussed. See also 3373 of 1952 (Leroy).

621.372.5 **3492**

Some Passive Networks under Transient Conditions.—M. D. Indjoudjian. (*Onde élect.*, May & June 1954, Vol. 34, Nos. 326 & 327, pp. 441–448 & 534–535.) Two groups of passive quadripoles are defined by their transfer functions: (*a*) those approximating to an ideal delay line; (*b*) those producing a Gaussian waveform from an input pulse of sufficiently short duration. A method of synthesizing such networks, given the attenuation and phase-shift coefficients, is based on a continued-fraction expansion of the quotient of a hypergeometric function.

621.372.54 **3493**

The Four-Circuit Filter with Coupled Circuits of Equal Resonance Frequency.—H. Behling. (*Fernmeldetech. Z.*, June 1954, Vol. 7, No. 6, pp. 302–306.) The properties of the circuit are analysed and compared with those of two-stage and three-stage filters.

621.372.54 : 621.3.015.3 **3494**

Methods for the Calculation of Transient Distortion based on the General Properties of Transfer Functions.—S. Colombo. (*Cah. Phys.*, May 1954, No. 49, pp. 1–22.) Theories of transients in filters developed by Küpfmüller, Wheeler and Cotte are compared; Cotte's method of calculation is considered most suitable for the general investigation of transient distortion. A definition of bandwidth is proposed; it is shown that in the general case there is no simple analytical relation of the type derived by Küpfmüller between bandwidth and rise time. See also 3539 of 1953.

621.372.54.011.1 **3495**

Universal Formulae for the Calculation of Simple Filters.—K. Schmutz. (*Bull. schweiz. elektrotech. Ver.*, 26th June 1954, Vol. 45, No. 13, pp. 513–526.) Transfer properties and input impedance are given as functions of normalized frequency for filters with up to four tuned circuits for arbitrary ratio between source impedance and terminating impedance; the calculations take account of circuit losses. The formulae are evaluated and represented in curves. Details of the calculation are shown for a four-circuit band-pass filter. A table is given of the most important filter circuits, with the associated formulae and definitions.

621.372.542.2 : 621.318.5 **3496**

Analysis of a Special-Purpose *RC* Filter incorporating a Periodically Conducting Bilinear Element.—V. W. Bolie. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1435–1438.) The circuit discussed is essentially a low-pass filter incorporating a two-way switch. Modulated carrier is applied, and the switch is operated at carrier frequency, so that the output is a series of amplitude-modulated pulses. Analysis is presented, based on consideration of the stepwise accumulation of charge by the capacitor, and taking account of the dead time when the switch is out of contact. Application in the field of automatic control is mentioned.

621.372.543.2 **3497**

Band-pass Circuits with Minimum Number of Coils: Part 1 — Band-pass Filters with Prescribed Attenuation Characteristic.—G. Bosse. (*Frequenz*, June 1954, Vol. 8, No. 6, pp. 186–192.) Any band-pass filter, with the exception of the equalized-characteristic-impedance type, can be constructed using a suitable combination of the basic filter sections described. By transforming parts of the filter, using the circuit equivalents given, the number of circuit components can be reduced; this is illustrated by a numerical example.

621.373 : 517.942.932 **3498**

On the Transformations of Singularities and Limit Cycles of the Variational Equations of van der Pol.—A. W. Gillies. (*Quart. J. Mech. appl. Math.*, June 1954, Vol. 7, Part 2, pp. 152–167.) Cartwright's solution of van der Pol's equation with forcing term (2740 of 1948) is shown to be incorrect in one range of the parameters; the corrected solution is given. In view of the correction, the hysteresis effects to be expected for a van der Pol oscillator with increasing and decreasing frequency are confined to a narrower frequency interval and are less varied in character than suggested by Cartwright's solution.

621.373.4 **3499**

Wien-Bridge Oscillator Design.—J. M. Diamond. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, p. 1449.) Comment on 1278 of 1953 (Clarke).

621.373.4 : 517.9 **3500**

Modes of Operation of a Valve Oscillator.—S. S. Ryshkov. (*C. R. Acad. Sci. U.R.S.S.*, 11th June 1954, Vol. 96, No. 5, pp. 921–924. In Russian.) The operation of a tuned-grid oscillator is described mathematically by the differential equation $\ddot{x} + x = \mu\lambda(x)\dot{x}$, where $\lambda(x) = \alpha\chi(x) - 1$, x is proportional to the capacitor voltage, $\chi(x)$ is the derivative of the anode current with respect to x and μ and α are constants dependent on the circuit parameters. The equation is solved assuming μ to be small.

621.373.4 : 621.396.822 **3501**

Fluctuations in Oscillator with Inertial Nonlinearity.—M. E. Zhabotinski. (*Zh. eksp. teor. Fiz.*, June 1954, Vol. 26, No. 6, pp. 758–759.) Fluctuations in a valve oscillator, the steady-state amplitude in which is determined by an inertial nonlinearity, such as a feedback system, are considered theoretically and some practical conclusions are reached on the choice of circuit parameters for minimum amplitude fluctuations.

621.373.432 **3502**

Verification of a Descriptive Theory of Relaxation Oscillations.—P. Jean. (*C. R. Acad. Sci., Paris*, 24th May 1954, Vol. 238, No. 21, pp. 2059–2061.) The conditions for oscillation established previously (3172 of November) are verified for the case of an oscillator using a neon lamp or a thyratron.

621.373.443 **3503**

New Circuits for Generating Pulses by means of a Pulsed Reactor.—H. Grasl. (*Elektrotech. u. Maschinenb.*, 1st June 1954, Vol. 71, No. 11, pp. 281–287.) Review of circuits containing a saturable reactor with rectangular magnetization characteristic for deriving pulses of required amplitude and phase from a sine-wave input. The method of shifting the phase by means of an auxiliary pre-magnetizing current is described. Pulse shapes obtainable from a square-wave input are discussed and practical circuits for deriving this input from single- and three-phase a.c. are shown.

621.373.52 **3504**

Junction Transistor Pulse Forming Circuits.—J. B. Oakes. (*Electronics*, Sept. 1954, Vol. 27, No. 9, pp. 165–167.) Analysis of integrating and differentiating circuits using *n-p-n*-junction transistors. Practical arrangements are illustrated for obtaining sawtooth, square and triangular pulses.

621.373.52 : 621.314.7 **3505**

Internal Oscillations in Transistors.—H. E. Hollmann. (*Z. Phys.*, 21st June 1954, Vol. 138, No. 1, pp. 1–15.) See 2540 of August.

621.374 : 621.372.2 **3506**

Pulse-Frequency Multiplication and Division by Delay Lines.—H. Zemanek. (*Wireless Engr*, Oct. 1954, Vol. 31, No. 10, pp. 264–265.) Analysis is given for simple arrangements of lumped-element *LC* lines. For multiplication, lines with linear characteristics are suitable. For division, a nonlinear device, e.g. a pentode, must be included; in this case the input may be sinusoidal.

621.375.2 : 621.385.15 **3507**

An Amplifier with Low Dissipation and Short Rise-Time for C.R.T.—D. Brini, L. Peli, O. Rimondi & P. Veronesi. (*Nuovo Cim.*, 1st June 1954, Vol. 11, No. 6, pp. 651–654. In English.) By using electron-multiplier valves in an amplifier for scintillation-counter pulses, a gain of about 400 and rise-time of 5–7 mμs are obtained with only a few valves. Details are given of a circuit for a negative-pulse input, giving an output of about 45 V.

621.375.2.029.3 **3508**

Newly Developed Amplifiers for the Sound Programme Chain.—S. D. Berry. (*B.B.C. Quart.*, Summer 1954, Vol. 9, No. 2, pp. 111–122.) As part of a comprehensive redesign of studio and control-room equipment—to be known as Type B—the B.B.C. Engineering Division has produced a new group of amplifiers comprising (*a*) GPA/4 and GPA/4A general-purpose level-raising amplifiers, (*b*) C/9, low-fixed-gain amplifier, for sending programme to line, and (*c*) MNA/3, for monitoring purposes. Compactness and standardization of construction are features. The preferred amplifying valve is the double triode Type CV455 or its 'trustworthy' equivalent, the Type 6060. Details are given of circuits, construction, mounting and performance.

621.375.221.1 **3509**

Design of Carrier-Frequency Amplifiers with Stagger-Tuned Resonant Circuits.—W. Händler. (*Arch. elekt. Übertragung*, June 1954, Vol. 8, No. 6, pp. 253–258.) A simple rule is derived for the distribution of the poles, and a nomogram is given facilitating the design of an amplifier with flat response over a pass band of large relative width. Analysis is also given for the case of response ripples within predetermined limits. Values of the resonant-circuit elements are calculated.

621.375.226 **3510**

Experimental Band-Pass Amplifier.—P. Hontoy. (*Rev. HF, Brussels*, 1954, Vol. 2, No. 11, pp. 311–320.) A description is given of the practical design of an amplifier circuit in which the bandwidth can be adjusted and the gain varied between wide limits without shifting the centre frequency of 455 kc/s or affecting the response curve. Features of the design are the capacitive coupling of the tuned circuits, the neutralization of the grid-anode capacitance of a Type-6SG7 pentode by means of a specially constructed plunger-type capacitor, and the compensation of valve input impedance variations by a suitable cathode load.

621.375.227.024 **3511**

A Stable Wide-Range D.C. Amplifier.—F. F. Offner. (*Rev. sci. Instrum.*, June 1954, Vol. 25, No. 6, pp. 579–586.) Description of an a.c.-operated differential push-pull amplifier for biological applications, with a range from zero to > 30 kc/s and a maximum gain of about $2{\cdot}5 \times 10^6$. Response can be controlled independently at the high and low ends of the range; the d.c. gain can be reduced to 1% of the mid-band gain. An automatic rebalancing circuit resets the zero of the amplifier at intervals of about 5 sec.

621.375.3 **3512**

Amplification of Small Alternating Voltages with the Magnetic Amplifier.—F. Kümmel. (*Elektrotech. Z., Edn A*, 1st June 1954, Vol. 75, No. 11, pp. 367–372.) A theoretical investigation of the conditions under which saturated reactors are suitable for amplifying small alternating voltages. A parallel-choke circuit with self-saturation was found to be suitable, and a two-stage 500-c/s amplifier based on this circuit is described. The amplification obtainable is sufficient to give a galvanometer indication with voltages down to 0·25 mV.

621.375.4 : 621.314.7 **3513**

The Attainment of Very High Gain with Unmatched Transistors.—W. Herzog. (*Arch. elekt. Übertragung*, June 1954, Vol. 8, No. 6, pp. 279–282.) When a transistor is used with unmatched source or load impedance, maximum gain is achieved with a particular value of the impedance on the other side; quadripole analysis is used to determine this optimum impedance value. With grounded-base or grounded-emitter circuits the cut-off frequency is the same as with matched impedance; with grounded-collector circuits the cut-off frequency depends on the degree of matching.

GENERAL PHYSICS

534.26 + [535.43 : 538.566 **3514**

Certain Transmission and Reflection Theorems.—V. Twersky. (*J. appl. Phys.*, July 1954, Vol. 25, No. 7, pp. 859–862.) Established theory [see e.g. 1898 of 1950 (Papas)] is used to analyse transmission and reflection of e.m. and acoustic waves by a

uniform planar distribution of cylinders. Reflection by a planar distribution of bosses is also considered. See also 695 of 1953 and back references.

535.12 : 535.31 **3515**

Step-by-Step Transition from Wave Optics to Ray Optics in Inhomogeneous Anisotropic Absorbing Media: Part 3 — Group Propagation.—K. Suchy. (*Ann. Phys., Lpz.*, 13th June 1954, Vol. 14, Nos. 6/8, pp. 412–425.) The method of stationary phase is applied to obtain general expressions for group delay, direction and velocity, which are then particularized for e.m. waves. Part 2: 1372 of May.

537.221 **3516**

Contact Charging between Nonconductors and Metal.—J. W. Peterson. (*J. appl. Phys.*, July 1954, Vol. 25, No. 7, pp. 907–915.) The investigation previously reported (2622 of September) was continued, using spheres of fused quartz and borosilicate glass rolling on a clean Ni surface, and introducing improvements in the method. The surface conductivity of the glass was found to be higher than that of the quartz by three or four orders of magnitude; since the charging of the two materials was of the same order of magnitude, it appears that the effective work function of the glass is considerably higher than that of the quartz.

537.226 : 539.11 **3517**

Rigorous Method for Investigation of the Interaction between an Electron and Several Lattice Oscillators.—H. Haken. (*Z. Phys.*, 21st June 1954, Vol. 138, No. 1, pp. 56–70.)

537.29 : 536.253 **3518**

Electrothermal Convection in Air.—A. G. Ostroumov. (*Zh. tekh. Fiz.*, June 1954, Vol. 24, No. 6, pp. 1055–1061.) The effect of an inhomogeneous electric field on the thermal gradients in air was investigated using air heated electrically by a filament of length 33·6 cm along the axis of a glass tube of diameter about 12 cm. Results show that the field required to produce electrothermal convection is lower at high power dissipation than at low dissipation in the range 1–150 W; the transition between gravitational-thermal and electrothermal convection occurs discontinuously. The potential difference between the positive filament and negative electrodes, placed on either side of the filament, was varied between about 10^3 and 10^4 V. Interference photographs are shown and the apparatus used is described. Results are presented graphically.

537.311.33 **3519**

Theory of Equations of Transport in Strong Electric Fields.—G. M. Abak'yants. (*Zh. eksp. teor. Fiz.*, May & June 1954, Vol. 26, Nos. 5 & 6, pp. 562–575 & 668–679.) The transport of heat and electricity in semiconductors is considered in terms of an electron (hole) gas whose kinetic energy is greatly increased in a strong electric field. Equations for the thermal and electric currents are derived and formulae are obtained for the thermoelectric and galvanomagnetic effects. These include the Thomson, Hall, Nernst and Nernst-Ettinghausen effects. Effects due to bipolar conduction of the semiconductor, including the photomagnetic effect, are also considered.

537.311.5 **3520**

An Analysis of the Distribution of Alternating Current in a Solid Cylindrical Conductor.—S. A. Swann. (*Elect. J.*, 4th June 1954, Vol. 152, No. 23, pp. 1830–1832.) The equivalent-circuit method of approach selected is designed to keep the physical basis of the problem in view at every stage of the work. The expressions derived apply to a 'conductor' of any material.

537.311.62 **3521**

The Theory of the Anomalous Skin Effect in Anisotropic Metals.—E. H. Sondheimer. (*Proc. roy. Soc. A*, 22nd June 1954, Vol. 224, No. 1157, pp. 260–272.) The theory of the anomalous skin effect in metals is extended to a uniaxial metal crystal containing two energy bands in each of which the energy surfaces are ellipsoids of revolution about the crystal axis. Explicit formulae are obtained for the extreme anomalous limit giving the dependence of the surface impedance on the orientation of the crystal axis, both for a plane metal surface and for a circular wire. The results are evaluated numerically for tin, and the surface conductivity of a circular wire is found to show the minimum observed by Pippard (329 of 1951); the parameters can be chosen to give reasonable agreement with Pippard's results.

537.311.62 **3522**

The Anomalous Skin Effect in Anisotropic Metals.—A. B. Pippard. (*Proc. roy. Soc. A*, 22nd June 1954, Vol. 224, No. 1157, pp. 273–282.) Application of the 'ineffectiveness concept' (1014 of 1948) leads to the same answer as Sondheimer's exact method (3521 above) for spheroidal Fermi surfaces and for a two-dimensional isotropic metal. A complete solution for the general case is given in a form which illustrates the potential value of anomalous-skin-effect studies as a tool in determining the shape of the Fermi surface of a real metal.

537.311.62 : 535.137 **3523**

The Anomalous Skin Effect and the Reflectivity of Metals.—C. W. Benthem & R. Kronig. (*Physica*, May 1954, Vol. 20, No. 5, pp. 293–300.) If the gas of conduction electrons is subject to internal friction the resultant energy dissipation contributes to the absorption factor of metallic conductors; this contribution can become predominant at low temperatures. If this effect is combined with those studied by Dingle (2626 of September) for the case of mean free path comparable with skin depth, agreement between theory and experiment is improved.

537.525.8 : 538.56 **3524**

Striated High-Frequency Discharge.—Kh. A. Dzherpetov & A. A. Zaitsev. (*C. R. Acad. Sci. U.R.S.S.*, 11th April 1953, Vol. 89, No. 5, pp. 825–828. In Russian.) The forming of striae in Ne and Ar at a pressure of 1·8 mm Hg by h.f. fields of frequencies 6×10^6 and 10^9 c/s is described. In symmetrical h.f. discharges the striae are stationary but on disturbing the symmetry, e.g. by using electrodes of unequal dimensions, the striae are set in motion. Their velocity in electropositive gases is of the order of the drift velocity of the positive ions. Both external and internal electrodes were used in the experiments.

537.525.8 : 538.56 **3525**

Theory of Striae in Gas Discharge.—M. F. Shirokov. (*C. R. Acad. Sci. U.R.S.S.*, 11th April 1953, Vol. 89, No. 5, pp. 837–840. In Russian.) Equations are derived connecting the spacing of striae with the radius of the discharge tube, the diffusion coefficient and other parameters. The calculated spacing is in good agreement with the spacing observed by Dzherpetov & Zaitsev (3524 above) and others.

537.525.83 **3526**

The Hollow-Cathode Effect and the Theory of Glow Discharges.—P. F. Little & A. von Engel. (*Proc. roy. Soc. A*, 22nd June 1954, Vol. 224, No. 1157, pp. 209–227.) The electric field between two plane parallel cathodes was investigated by observing the

deflection of an electron beam and simultaneously noting other discharge parameters. Results show that the field in the two cathode dark spaces falls linearly with distance from the cathode and thus the net space-charge density is constant as in a conventional discharge. The dark-space length was also determined. The conclusions lead to a theory of glow discharges which takes account of the effect of ultraviolet quanta from the glow on the photoelectric emission from the cathodes. The discrepancy between earlier experimental results, showing that ions of energy of the order of cathode fall of potential arrive at the cathode, and classical calculations leading to low ion energies, is resolved by allowing for small-angle scattering and charge transfer.

537.533 **3527**

Electrical Circuit for the Direct Determination of the Energy-Distribution Function of Secondary Electrons.—N. B. Gornyi & L. M. Rakhovich. (*Zh. eksp. teor. Fiz.*, April 1954, Vol. 26, No. 4, pp. 454–458.) A circuit modification of the retarding-field method is described, by means of which the current/voltage characteristic is differentiated; this results in improved accuracy and resolution as compared to numerical differentiation. Results of measurements on an oxide-caesium cathode are shown graphically.

537.533 **3528**

Anomalous Electron Emission from Tungsten Heated by High-Current-Density Pulses.—S. V. Lebedev & S. E. Khaikin. (*Zh. eksp. teor. Fiz.*, June 1954, Vol. 26, No. 6, pp. 723–735.) Results of this experimental investigation, using microsecond pulses with current densities up to about 10^7 A/cm², show that the instantaneous electron emission from W can exceed by a factor of 100 the steady saturation emission at the melting point.

537.533.8 : 546.841-3 **3529**

Secondary Electron Emission from Thoria.—A. R. Shul'man & I. D. Yaroshetski. (*Zh. tekh. Fiz.*, May 1954, Vol. 24, No. 5, pp. 845–847.) The dependence of the secondary-emission coefficient on primary-electron energy and on target temperature was determined experimentally for thoria layers, of thickness 50–100 μ, deposited on Ta. The effect of pre-treatment by heating to temperatures up to 1 900°C is shown.

537.534.8 **3530**

Method of Investigating Secondary Emission in Conductors Bombarded by Ions.—U. A. Arifov, A. Kh. Ayukhanov & S. V. Starodubtsev. (*Zh. eksp. teor. Fiz.*, June 1954, Vol. 26, No. 6, pp. 714–722.) Several oscillographic methods are discussed and the double-modulation method is described in detail. The ion beam is modulated by a rectangular pulse and the secondary-emission-electrode potential by a l.f. sawtooth pulse. The principal advantage of this method is the possibility of separating the true secondary ions from those produced by the heating due to the bombardment. Oscillograms of the current/voltage characteristics of the secondary emission are shown for Ta and W specimens bombarded by Rb ions.

537.56 **3531**

Theory of Probe in Plasma: Part 1.—Yu. M. Kagan & V. I. Perel'. (*Zh. tekh. Fiz.*, May 1954, Vol. 24, No. 5, pp. 889–894.) An expression is derived for the electron current into a spherical probe, which is at the potential of the space, in an undisturbed electron plasma. The dependence of the current on the probe dimensions and the electron mean free path is indicated.

537.562 : 538.56 **3532**

Dipole Resonant Modes of an Ionized Gas Column.—R. E. B. Makinson & D. M. Slade. (*Aust. J. Phys.*, June 1954, Vol. 7, No. 2, pp. 268–278.) A quasistatic treatment is used to show that numerous oscillation modes are possible in a cylindrical column of ionized gas with a rotationally symmetrical distribution of electron concentration. The theory provides a qualitative explanation of the reflection of 30-cm e.m. waves observed by Romell (1618 of 1951). Approximate values of the resonance frequencies are calculated, assuming a Gaussian radial distribution of electron concentration; some of the results may be verifiable by meteor-trail-echo observations. An investigation is also made of the finite energy loss and phase shift shown by Herlofson (403 of 1952) and others to occur when the real part of the dielectric constant vanishes.

537.568 **3533**

A Correction of the Thomson Formula for the Coefficient of Three-Body Recombination between Electrons and Ions.—C. T. J. Alkemade. (*Physica*, Feb. 1954, Vol. 20, No. 2, pp. 129–130.) Comment on the method of deriving Thomson's formula [999 of 1953 (Massey)] pointing out two objections to the expression used for effective mean free path.

538.12 **3534**

Solution of Magnetostatic Problem for Unbounded Homogeneous Anisotropic Medium.—A. S. Viglin. (*C. R. Acad. Sci. U.R.S.S.*, 21st May 1954, Vol. 96, No. 3, pp. 457–458. In Russian.)

538.566 **3535**

Asymptotic Evaluation of the Field at a Caustic.—I. Kay & J. B. Keller. (*J. appl. Phys.*, July 1954, Vol. 25, No. 7, pp. 876–883.) A determination is made of the field at and near the focus when a plane e.m. wave is incident on a parabolic cylinder. The case of a reflector comprising a segment of a circular cylinder is also considered.

538.566 : 535.42 **3536**

Diffraction at a Circular Aperture.—W. Braunbek. (*Z. Phys.*, 21st June 1954, Vol. 138, No. 1, pp. 80–88.) A discrepancy in the results obtained by two methods of calculating the diffraction field described earlier (2182 and 2183 of 1950) is examined. The first method is correct within the approximation stated; the second is invalid for a small region near the centre of the aperture when the wavelength is insufficiently small.

538.566 : 535.42 **3537**

Theory of Diffraction at a Sphere taking account of the Surface Wave.—K. Deppermann & W. Franz. (*Ann. Phys., Lpz.*, 13th June 1954, Vol. 14, Nos. 6/8, pp. 253–264.) Theory developed previously [1665 of 1953 (Franz & Deppermann)] is applied to the case of a sphere. The main difference found is an abrupt phase change in the surface wave as it passes over either pole.

538.566 : 535.42 **3538**

Diffraction of 3·2-cm Electromagnetic Waves by Cylindrical Objects.—S. T. Wiles & A. B. McLay. (*Canad. J. Phys.*, June 1954, Vol. 32, No. 6, pp. 372–380.) A brass tube and a hard rubber rod, both of diameter 1 in. and length 6 ft, were used as obstacles in the path of a plane pulsed wave with the electric vector parallel to the cylinder axis. Observations were made of the diffraction patterns in planes perpendicular to the direction of incidence. Experimental results for the brass cylinder are in good agreement with calculations based on scalar diffraction theory. The patterns for the rubber rod exhibit a pronounced peak immediately behind the

rod, and differ in other ways from the patterns for the brass tube, particularly in the vicinity of the shadow. The results are compared with those obtained by Kodis (2186 of 1952).

538.566 : 537.56 + 621.385.029.63/.64 **3539**

The Propagation of Electron Space-Charge Waves in Waveguides and Tubes with Periodic Structure.—Rydbeck & Agdur. (See 3723.)

538.569.4 : 621.317.756 **3540**

Method for Measurement of Absorption Coefficients by Microwave Spectroscopy.—A. M. Prokhorov & A. I. Barchukov. (*Zh. eksp. teor. Fiz.*, June 1954, Vol. 26, No. 6, pp. 761–763.) A technique using a modulated Stark cell is described with the aid of a diagram of the experimental set-up. Errors are estimated to be less than 10%.

538.691 **3541**

Focusing Electrified Particles.—A. Yu. Ishlinski. (*C. R. Acad. Sci. U.R.S.S.*, 1st June 1954, Vol. 96, No. 4, pp. 721–724. In Russian.) A relation is found between H, the magnetic field strength, and the coordinate x, such that the trajectories of charged particles in the xy plane pass through both the origin and a given point on the y axis. The particles are assumed to have equal mass and charge. $H(x)$ is derived in the form of a simple series.

539.23 : [537.311.31 + 537.311.33 **3542**

Physics of Thin Metal and Semiconductor Films.—I. D. Konozenko. (*Uspekhi fiz. Nauk*, April 1954, Vol. 52, No. 4, pp. 561–602.) A survey of work on: (*a*) formation, structure and electrical properties of thin metal and semiconductor films, (*b*) surface states and their effect on the properties of semiconductor films, (*c*) theoretical work on thin metal films. The present position is briefly but critically discussed and, in particular, the points of agreement and disagreement between experimental results and theory are noted. 99 references.

621.3.011.4 **3543**

The Capacitance of an Anchor Ring.—T. S. E. Thomas. (*Aust. J. Phys.*, June 1954, Vol. 7, No. 2, pp. 347–350.) An approximate value of $1{\cdot}74R$ (where R is the mean radius) is derived.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.852.3 : 621.396.822.029.63 **3544**

Observations of the 21-cm Line from the Magellanic Clouds.—F. J. Kerr, J. V. Hindman & B. J. Robinson. (*Aust. J. Phys.*, June 1954, Vol. 7, No. 2, pp. 297–314.) First observations of this neutral-hydrogen line from an extragalactic source are reported.

523.852.3 : 621.396.822.029.62 **3545**

The Distribution of Radio Brightness across the Crab Nebula.—J. E. Baldwin. (*Observatory*, June 1954, Vol. 74, No. 880, pp. 120–123.) Interferometer measurements were made at λ 1·4 m with aerial spacings 10 λ–300 λ on an E-W axis and 3 λ–40 λ on a N-S axis. Information regarding phase was obtained from independent measurements of the position of the source. Results show that brightness distribution is symmetrical and that optical and radio centres of the source coincide within $\frac{1}{2}'$ of arc.

538.12 **3546**

The Motion of Magnetic Fields.—J. W. Dungey. (*Mon. Not. R. astr. Soc.*, 1953, Vol. 113, No. 6, pp. 679–682.) "The temporal change of a magnetic field cannot be described as a motion if it involves interlinking of the lines of force. It is shown that the idea of motion can be retained, if the lines of force are regarded as being 'disconnected' on a suitable surface. A process is described by which magnetic flux can be generated other than at a neutral line."

550.37 : 550.384 **3547**

Electric Field induced by Vertical Component of Geomagnetic Variations.—A. P. Bondarenko. (*C. R. Acad. Sci. U.R.S.S.*, 21st May 1953, Vol. 90, No. 3, pp. 367–370. In Russian.) An expression is derived for the horizontal electric field in the earth due to a varying geomagnetic field, assuming regions of unequal electrical conductivities. Graphs based on published experimental determinations of the electric field components and the geomagnetic field show typical 24-hour cycles and indicate the degree of correlation between the electric and geomagnetic fields. See also 1412 of May.

550.372 **3548**

An Effective Ground Conductivity Map for Continental United States.—H. Fine. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1405–1408.) Discussion of a map, based on the sectional maps described by Kirby et al. (2381 of August), which has been adopted by the F.C.C.

550.384 : 551.510.535 **3549**

Atmospheric Oscillations at High Altitudes and their Relation to Geomagnetic Field Variations.—R. Pratap. (*Proc. nat. Inst. Sci. India*, May/June 1954, Vol. 20, No. 3, pp. 252–258.) Equations developed previously [2384 of August (Chakrabarty & Pratap)] are used to calculate the S_q variations of H and V. By assuming different phases for the atmospheric oscillations in the ionosphere layer which is the seat of the ring currents, and comparing the results with observed variations of the magnetic field, a phase of 275° is found to give the best fit.

551.510.535 **3550**

The Action of Solar Particles in the Ionosphere.—W. Dieminger. (*Arch. elekt. Übertragung*, June 1954, Vol. 8, No. 6, pp. 259–268.) An examination is made of typical changes occurring in the ionosphere during the penetration of solar particles inside and outside the zone of northern lights, and Martyn's extension (1374 of 1951) of the Chapman-Ferraro theory is discussed.

551.510.535 **3551**

Energy and Duration of a Sudden Ionospheric Disturbance.—N. C. Gerson. (*Geofis. pura appl.*, Jan./April 1954, Vol. 27, pp. 156–158.) "A study was made of the maximum amount of energy which might be absorbed by the atmosphere down to 80 km during a sudden ionospheric disturbance. Assuming that the ionization is caused by Lyman α radiation from the sun, and that all oxygen present is ionized, the energy absorbed by the sunlit hemisphere is $5{\cdot}65 \times 10^{27}$ ergs."

551.510.535 **3552**

Symposium on Ionospheric Storms, May 13, 1953.—(*Rep. Ionosphere Res. Japan*, March 1954, Vol. 8, No. 1, pp.1–44.) The full text is given of papers presented at the symposium.

551.510.535 **3553**

A Theory of Diurnal Magnetic Variations in Equatorial Regions and Conductivity of the Ionosphere E Region: Part 2.—M. Hirono. (*J. Geomag. Geoelect.*, June 1953, Vol. 5, Nos. 1/2, pp. 22–38.) "The electrical conductivity of the E region is calculated in

some detail for two atmospheric models. It is shown that the factor, by which the tidal oscillation of the E region exceeds that at ground level, should be less than 10^3, in order to give the observed lunar magnetic variation. The calculated lunar vertical movement of the E region is nearly in phase with that observed in south England and nearly opposite at Canberra. A possibility is shown that the calculated lunar vertical movement of the F_2 region roughly agrees with that observed. It is suggested that the vertical drifts of the F_2 region near the magnetic equator may be much greater than those in the other latitudes."

551.510.535 : 550.384.4 **3554**

Ionospheric Variations Associated with Geomagnetic Disturbances: Part 1—Variations at Moderate Latitudes and the Equatorial Zone and the Current System for the Sp Field.—S. Matsushita. (*J. Geomag. Geoelect.*, Dec. 1953, Vol. 5, No. 4, pp. 109–135.) Variations of the E_s and F_2 regions are studied. The current system for the Sp field is calculated. The ionospheric Sp variations may be due to the effect of a vertical drift by the earth's magnetic field and the electric field of the Sp current. See also 2936 of October.

551.510.535 : 550.385 **3555**

Disturbances in the Ionosphere during the Geomagnetic Storm of April 18, 1951.—H. Kamiyama. (*Rep. Ionosphere Res. Japan*, March 1954, Vol. 8, No. 1, pp. 32–34. Discussion, p. 34.) Analysis shows that commencement of disturbances of the F_2-layer electron density and virtual height coincided with the commencement of the main phase of the magnetic storm.

551.510.535 : 550.385 **3556**

Characteristics of Ionospheric Disturbance during a Severe Magnetic Storm.—K. Miya. (*Rep. Ionosphere Res. Japan*, March 1954, Vol. 8, No. 1, pp. 35–38. Discussion, p. 38.) Data from 40 ionospheric stations relevant to the storm of 9th May 1948 are analysed and the salient characteristics explained.

551.510.535 : 551.55 : 621.396.822 **3557**

A Radio Astronomical Investigation of Drift Movements in the Upper Atmosphere.—A. Maxwell & M. Dagg. (*Phil. Mag.*, June 1954, Vol. 45, No. 365, pp. 551–569.) Discussion of night-time observational data of the diffraction of r.f. radiation from radio stars by moving irregularities in the ionosphere F region, obtained at Jodrell Bank during the period April 1951–April 1953, using three receiving equipments triangularly sited and operating at 3·7 m. The drift velocity at temperate latitudes is normally of the order of 50–300 m/s. During the first half of the night the prevailing direction is westwards, during the second half eastwards, the reversal occurring around 0100. In the auroral zone, the velocity is of the order of 400 m/s, and the changes in direction are less marked. Results for points separated by 800 km suggest that the drift speed and directions are the same over wide areas.

551.593.9 **3558**

Glow of the Night Sky in the 1–3-μ Waveband.—A. L. Osherovich & S. F. Rodionov. (*C. R. Acad. Sci. U.R.S.S.*, 21st June 1954, Vol. 96, No. 6, pp. 1159–1160. In Russian.) Results are reported of energy flux measurements made at the Gorni observatory (altitude 2 130 m) in September 1953. The average flux per second crossing 1 cm^2 received from 1 steradian in the direction of Cygnus α varied between $3{\cdot}9 \pm 1{\cdot}3 \times 10^{-2}$ and $6{\cdot}3 \pm 1{\cdot}6 \times 10^{-2}$ (units not stated) referred to a wavelength of 1·72 μ. The apparatus used is briefly described.

551.594 : 523.78 **3559**

Observations of the Electric Field of the Atmosphere at Monaco during the Partial Solar Eclipse of 30th June 1954.—J. Rouch. (*C. R. Acad. Sci., Paris*, 9th Aug. 1954, Vol. 239, No. 6, pp. 465–466.) Very high values of field strength were observed after the maximum of the eclipse.

551.594.6 **3560**

Atmospherics due to Fronts in the Upper Atmosphere.—A. Kimpara. (*J. Geomag. Geoelect.*, June 1953, Vol. 5, Nos. 1/2, pp. 8–13.) Reference to meteorological data indicates that atmospherics observed in a zone of the Pacific Ocean in latitude 30°–40°N, especially in autumn and winter, are generated in the convergence region of fronts in the upper atmosphere.

LOCATION AND AIDS TO NAVIGATION

534.88 **3561**

Nomograms for the Solution of the Sound-Ranging Problem in a Plane.—G. C. Curtis. (*Quart. J. Mech. appl. Math.*, June 1954, Vol. 7, Part 2, pp. 129–135.)

621.396.96 **3562**

A Textbook of Radar. [Book Review]—E. G. Bowen (Ed.). Publishers: Cambridge University Press, London, 2nd edn, 617 pp., 45s. (*Wireless Engr*, Oct. 1954, Vol. 31, No. 10, p. 284.) In this revised edition, only minor alterations have been made in the first 16 chapters, but the last four chapters have been rewritten as three chapters, covering military, civil and scientific applications.

MATERIALS AND SUBSIDIARY TECHNIQUES

531.788.7 **3563**

Cold-Cathode Ionisation Gauges for the Measurement of Low Pressures.—G. K. T. Conn & H. N. Daglish. (*Vacuum*, Jan. 1953, Vol. 3, No. 1, pp. 24–34.) Construction, characteristics and performance of various types are reviewed. The influence of the size and shape of electrodes, the applied voltage, the magnetic field and the nature of the residual gas is discussed. Pressures as high as 10^{-2} mm Hg may be measured using gauges with small anode rings and relatively small ballast resistors. Experiments confirm that e.m. radiation at h.f. is due to plasma oscillations.

533.15 : 533.5 **3564**

Diffusion Coefficient, Solubility, and Permeability for Helium in Glass.—W. A. Rogers, R. S. Buritz & D. Alpert. (*J. appl. Phys.*, July 1954, Vol. 25, No. 7, pp. 868–875.) A method is described for simultaneously measuring diffusion coefficient, solubility and permeability of a given gas in a solid material. High-vacuum techniques [2102 of July (Alpert & Buritz)] are used. Values of the parameters are determined for the diffusion of helium in pyrex, and the effect of temperature variation is studied.

533.56 **3565**

The Distribution of Gas Concentration in a Vapour Vacuum Pump.—K. A. Savinski. (*Zh. tekh. Fiz.*, May 1954, Vol. 24, No. 5, pp. 875–878.) Results of an experimental investigation, the technique of which is described, show that the concentration of the gas being pumped out is a minimum near the cooling surface. Reference is made to Alexander's theory (1868 of 1946).

533.58 **3566**

The Use of Getters for the Production of Very High Vacua.—S. Wagener. (*Vacuum*, Jan. 1953, Vol. 3, No. 1, pp. 11–23.) Continuation of earlier work (2521 of 1952). The gettering rate for Ba decays rapidly during exposure to CO; this decay is ascribed to the formation of a protective surface film and makes the getter inefficient for other gases also. The use of Th powder as a selective getter is discussed; such materials remove oxidizing gases and establish a constant pressure of H_2 which can be controlled by varying the temperature of the getter and the quantity of H_2 dissolved in it. A hydrogen atmosphere at pressures of 10^{-7} to 10^{-6} mm Hg reduces the interface resistance of oxide cathodes by a factor of 10. See also 2675 of 1953.

535.37 **3567**

Determination of the Depths of Electron-Trap Energy Levels in Crystal Phosphors.—I. A. Parfianovich. (*Zh. eksp. teor. Fiz.*, June 1954, Vol. 26, No. 6, pp. 696–703.) An account is given of methods based on thermoluminescence curves for determining the activation energy of luminescence centres.

535.37 : 535.215 : 546.47-31 **3568**

Optical Absorption and Internal Photoeffect of Zinc Oxide.—K. V. Shalimova. (*C. R. Acad. Sci. U.R.S.S.*, 21st May 1954, Vol. 96, No. 3, pp. 487–490. In Russian.) The experimentally determined spectral characteristics of absorption and photocurrent in ZnO-Zn films are shown graphically and discussed in relation to recombination glow and photoeffect in sublimate phosphors.

535.37 : 537.311.33 **3569**

Electroluminescence of Semiconductor Phosphors.—A. Fischer. (*Z. Naturf.*, Nov. 1953, Vol. 8a, No. 11, pp. 756–757.) Luminescence was observed in sintered ZnO/Zn layers with electrodes of metal, graphite, ZnO or neutral electrolyte, with voltages as low as 5 V applied in one direction; higher voltages were required with reverse polarity. This rectification effect was particularly marked when the electrolyte was used as cathode. Space charge giving rise to e.s. field in the surface layers of the semiconductor is considered responsible for the luminescence. The quantitative aspect is examined; the magnitudes involved are consistent with the breakdown mechanism suggested by Franz (2148 of 1951).

535.37 : 546.121.3 **3570**

Sublimate Phosphors based on Halide Salts of Group-2 Metals.—F. D. Klement & I. F. Malysheva. (*C. R. Acad. Sci. U.R.S.S.*, 21st May 1954, Vol. 96, No. 3, pp. 465–468. In Russian.) The principal advantages of sublimate-phosphor screens are the high resolution, the stability and the even covering obtainable without the use of additional binding materials. Microphotographs (× 60) of $CdI_2.PbI_2$ phosphor deposited as sublimate and from a suspension are shown. Spectral characteristics and their variation by activators were investigated in (Cd-halide).(Hg-, Tl-, Pb-, Bi-, or Mn-halide) and in TlCl. (Ca-, Sr-, or Ba- halide) compounds. Results are shown graphically and are discussed from the point of view of lattice structure.

535.37 : 546.86 **3571**

Optical Properties of a New Luminescent Substance with Antimony Oxide Base.—R. Bernard & J. Janin. (*C. R. Acad. Sci., Paris*, 9th Aug. 1954, Vol. 239, No. 6, pp. 489–490.) Sb_2O_4 when activated by Mn exhibits orange luminescence on excitation by radiation of $\lambda < 3\,500$ Å.

537.227 **3572**

Dielectric Properties and Phase Transformations of Mixed-Crystal Systems of Perovskite Type.—H. Gränicher & O. Jakits. (*Nuovo Cim.*, 1954, Vol. 11, Supplement No. 3, pp. 480–520. In German.) Experimental and theoretical investigations are reported on alkaline-earth and rare-earth titanate ceramics. The ferroelectric anomalies of $BaTiO_3$ are found to be retained in mixed systems. The shift of Curie point and transformation point depends on whether the admixed component is or is not itself ferroelectric. Discontinuities in the temperature variation of the permittivity or of its temperature coefficient are observed in the case of $(CaSr)TiO_3$. Theory developed enables the dielectric behaviour of mixed crystals to be predicted from knowledge of the lattice constants and permittivities of the components at a given temperature.

537.311.3 **3573**

Variation of the Electric and Magnetic Properties of Sb and InSb at the Melting Point.—G. Busch & O. Vogt. (*Helv. phys. Acta*, 30th June 1954, Vol. 27, No. 3, pp. 241–248. In German). Measurements of conductivity, Hall coefficient and magnetic susceptibility were made over a range of temperatures. The conductivity of Sb increased by a factor of 1·6 while the Hall coefficient and susceptibility decreased by a factor of about 9 on melting. The conductivity of InSb increased by a factor of 4 while the Hall coefficient decreased by a factor of 450 and the susceptibility by a factor of 5·5. The theoretical interpretation of these results depends on whether liquid InSb is to be regarded as semiconductor or metal.

537.311.31 **3574**

Some Anomalies in the Conduction of Metals Heated by High-Current-Density Pulses.—S. V. Lebedev & S. E. Khaikin. (*Zh. eksp. teor. Fiz.*, May 1954, Vol. 26, No. 5, pp. 629–639.) An experimental investigation is reported of resistance and energy measurements on metal filaments at current densities up to about 10^7 A/cm². Oscillograms for W, Fe, Ag and Pb are shown and are discussed.

537.311.31 **3575**

The Electrical Resistivity of Cu-Ni Alloys and Matthiessen's Rule.—Y. Shibuya. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, June 1954, Vol. 6, No. 3, pp. 199–206.) The variation of resistivity with temperature and with composition was investigated experimentally. Deviations from Matthiessen's rule were observed for alloys with low Ni contents. An explanation based on electron conduction theory is advanced.

537.311.33 **3576**

Theory of Radiationless Recombination in Nonpolar Semiconductors.—L. Tewordt. (*Z. Phys.*, 2nd June 1954, Vol. 137, No. 5, pp. 604–616.)

537.311.33 **3577**

The Capacitance of Junction Layers in Semiconductors.—B. M. Vul. (*C. R. Acad. Sci. U.R.S.S.*, 11th May 1954, Vol. 96, No. 2, pp. 257–259. In Russian.) The junction layer is assumed to be bounded by the boundaries of the volume charges at which the electric field strength can be taken as zero. The boundaries of the volume charges can change under the influence of an externally applied voltage acting in addition to the contact potential difference. Using Poisson's equation in one dimension and assuming a volume distribution of charge which is an arbitrary function of distance, the capacitance of the layer is calculated from the rate of change of charge with respect to potential. In an example the capacitance of a layer in which the charge distribution is a function of the nth power of distance is calculated.

537.311.33 : 535.215 **3578**

Diffusion and Drift of Photoelectrons in Partly Illuminated Semiconductor.—A. I. Gubanov. (*Zh. tekh. Fiz.*, May 1954, Vol. 24, No. 5, pp. 933–940.) A calculation is made of the effects at the dark/light boundary, assuming one kind of charge carrier, and an external field perpendicular to the boundary. Cases of low and of high photoconductivity are considered, the electron distribution is calculated and the voltage/current characteristics are obtained for cases when one of the electrodes or the middle region of the specimen is illuminated.

537.311.33 : 538.63 **3579**

Theory of Magnetic Effects in Isotropic Semiconductors with High Mobility.—O. Madelung. (*Z. Naturf.*, Dec. 1953, Vol. 8a, No. 12, pp. 791–795.) Weak-magnetic-field theory is inadequate to explain Hall-effect and resistance variations in high-mobility semiconductors because the product of mobility and magnetic field occurs as the determining factor. For high-mobility mixed semiconductors, in particular, the Hall coefficient is markedly dependent on the field, and may change sign with increase of field strength. The resistance variation approaches a saturation value as the strength of the magnetic field increases.

537.311.33 : 538.63 : 535.215.9 **3580**

New Photomagnetic Effect in Semiconductors in an Inhomogeneous Magnetic Field.—I. K. Kikoin. (*C. R. Acad. Sci. U.R.S.S.*, 21st May 1954, Vol. 96, No. 3, pp. 463–464. In Russian.) The e.m.f. produced by illuminating short bars of CdS, Cu_2O, or Ge in an inhomogeneous magnetic field is the resultant of the known photomagnetic effect, which is a function of the mean magnetic field at the bar, and of the new effect, which is a function of the difference of the squares of the field strengths at the ends of the bar. For a Ge bar with magnetic fields of $\sim 10^4$ and $\sim 4{\cdot}10^3$ oersted respectively at the two ends, the current is of the order of 3 μA.

537.311.33 : 539.23 **3581**

Resistance and Photoconductivity of PbS Films at High Frequencies of the Applied Voltage.—V. V. Balakov & V. A. Smeshkova. (*Zh. tekh. Fiz.*, June 1954, Vol. 24, No. 6, pp. 989–992.) The characteristics of PbS films, prepared both by evaporation and by chemical means, were investigated experimentally at frequencies up to 200 Mc/s. The conclusions agree with those of Humphrey et al. (2682 of 1953). Particular attention was paid to good electrode contacts; the metal electrodes were deposited in vacuum and the leads soldered on using Wood's alloy. Results are shown graphically.

537.311.33 : 546.23 **3582**

Conductivity Measurements on Selenium.—F. Eckart. (*Ann. Phys., Lpz.*, 13th June 1954, Vol. 14, Nos. 6/8, pp. 233–252.) The dependence of conductivity on temperature was investigated for Se in the solid and liquid states. Results differ according to the purity of the samples, and to the method of production, and are markedly affected by the presence of oxygen. An activation energy of 2·2–2·9 eV is obtained for the temperature range of 100°C to melting point.

537.311.33 : 546.23 **3583**

Electrical Conductivity of Amorphous Selenium in Strong Electric Fields.—M. K. Shidlovski. (*Zh. tekh. Fiz.*, May 1954, Vol. 24, No. 5, pp. 837–844.) Conductivity was determined experimentally at temperatures in the range from $-35°$ to $+50°$C and at field strengths between 0·2 and 180 kV/cm. Results, shown graphically, are in agreement with Frenkel's theory.

537.311.33 : 546.28 **3584**

A Note on the Band Structure of Silicon.—D. G. Bell, R. Hensman, D. P. Jenkins & L. Pincherle. (*Proc. phys. Soc.*, 1st June 1954, Vol. 67, No. 414A, pp. 562–563.) Calculation by the cellular method shows that triply degenerate states bound the forbidden energy gap above and below at the origin of **k** space.

537.311.33 : 546.289 **3585**

Surface Conduction Channel Phenomena in Germanium.—H. Christensen. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1371–1376.) An optical method was used to study the effect of surface polarization layers on junction leakage and to identify surface conduction channels. Such channels were produced on both *n*-type and *p*-type regions of a Ge junction, the former by exposure to an oxygen-rich atmosphere, the latter by high humidity. At the medium relative humidity value of 75%, high surface leakage was observed and no channel. Mechanisms involved are explained on the basis of a model in which the energy levels bend at the surface, corresponding to reversal of conduction type. Results are discussed in relation to anomalous behaviour of transistors.

537.311.33 : 546.289 **3586**

A Mechanism for Water-Induced Excess Reverse Dark Current on Grown Germanium *N-P* Junctions.—J. T. Law. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1367–1370.) Three groups of experiments are reported: (*a*) measurements of the adsorption isotherm for water on Ge; (*b*) determinations of the number of foreign ions on a Ge surface; (*c*) measurements of reverse current in *n-p* junctions under various conditions. The results indicate that ionic processes as well as electronic channels [166 of January (Brown)] contribute to the increase of reverse current which is observed when the ambient humidity is increased.

537.311.33 : 546.289 **3587**

Channels and Excess Reverse Current in Grown Germanium *p-n* Junction Diodes.—A. L. McWhorter & R. H. Kingston. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1376–1380.) Using the same optical technique as Christensen (3585 above), measurements were made of the length of *n*-type channels formed on the surface of the *p* side of the junction on exposure to water vapour. Direct proportionality was found between channel length and excess reverse current. The effect was observed with well oxidized surfaces, in contradistinction to the case discussed by Law (3586 above). By combining this result with the known variation of channel conductivity with humidity and voltage, a relation is derived between the excess current and the bias. Agreement between predicted values and experimental results is reasonably good for bias values > 1 V.

537.311.33 : 546.289 **3588**

Phenomena Observed in the Melting and Solidification of Germanium.—S. E. Bradshaw. (*J. electrochem. Soc.*, June 1954, Vol. 101, No. 6, pp. 293–297.) Small spheres of molten Ge, weighing about 10 mg, on freezing form pear-shaped bodies which are substantially single crystals. A mechanism is suggested to account for the shape and impurity distribution. Shape depends on the ratio of densities of liquid and solid Ge at the melting point. Theory indicates that the melting point is lowered initially by an increase of pressure. Ge may undergo an allotropic modification under pressure such as that exerted locally by a whisker contact.

537.311.33 : 546.289 **3589**

The Solid Solubility and the Diffusion of Nickel in Germanium.—F. van der Maesen & J. A. Brenkman. (*Philips Res. Rep.*, June 1954, Vol. 9, No. 3, pp. 225–230.) Ni produces rapidly diffusing acceptors in Ge; the Ni acceptor level lies 0·23 eV above the valence band, according to Hall-effect and resistivity measurements. On this basis, the solid solubility between 700° and 900°C is derived from resistivity measurements, and the distribution and diffusion coefficients are calculated. The distribution coefficient is $1{\cdot}8 \times 10^{-6}$ at the melting point of Ge. The activation energy of diffusion is 21 kcal/mole. Annealing of a Ni-saturated Ge sample restores the original resistivity.

537.311.33 : 546.289 : 538.63 **3590**

Magnetic Blocking Layers in Germanium.—E. Weisshaar & H. Welker. (*Z. Naturf.*, Nov. 1953, Vol. 8a, No. 11, pp. 681–686.) Theoretical considerations indicate that application of a transverse magnetic field to a current-carrying intrinsic semiconductor with high electron and hole mobilities may produce appreciable variation of the concentration of electron-hole pairs if volume and surface recombination are sufficiently low. This should be evidenced by a nonlinear current/voltage characteristic linked with a far greater variation of resistance in the magnetic field than normal. Such an effect has been demonstrated in Ge. A positive variation of 470% and a negative variation of 13% have been produced with fields in opposite directions. Measurements of photoelectric effect and variations with frequency indicate the applicability of the theory to the observed effects.

537.311.33 : 546.46.86 **3591**

Electrical Properties of the Intermetallic Compound Mg_3Sb_2.—G. Busch, F. Hulliger & U. Winkler. (*Helv. phys. Acta*, 30th June 1954, Vol. 27, No. 3, pp. 249–258. In German.) Measurements were made of the conductivity, Hall coefficient and thermoelectric voltage of a polycrystalline specimen of the α-phase compound, obtained by melting the components together, over a range of temperatures. The width of the forbidden energy band is found to be 0·82 eV. Hall coefficient and thermoelectric voltage both have positive sign up to very high temperatures; this is interpreted as indicating that the mobilities of the holes are greater than those of the electrons. The concentrations, mobilities and availability coefficients of electrons and holes are determined from the measurements.

537.311.33 : 546.482.21 **3592**

Dependence of Induced Conductivity of CdS Films and Single Crystals on the Energy of the Exciting Electrons.—S. M. Ryvkin, B. M. Konovalenko & Yu. S. Smetannikova. (*Zh. tekh. Fiz.*, June 1954, Vol. 24, No. 6, pp. 961–977.) The electron-irradiation-produced conductivity is independent of the electron energy in the range from approximately 10 keV to 30 keV, but falls off at lower energies. This is probably due to the different depths of penetration. An analogy is drawn with the photoconductivity characteristics of CdS. The experimental arrangements are described and results are shown graphically. The range up to 2–3 keV was investigated earlier by Benda (1628 of 1952) and others.

537.311.33 : 546.561-31 **3593**

The Semiconductor Properties of Cu_2O: Part 9 — Hall-Effect Measurements at Low Temperatures.—P. Schmidt. (*Ann. Phys., Lpz.*, 13th June 1954, Vol. 14, Nos. 6/8, pp. 265–289.) Measurements were made from room temperature down to about −160°C. Observed anomalies in the Hall-effect/temperature curves are ascribed to changes in the relative concentration of excess electrons and holes, due to changes in the surface-layer conductivity. Part 8: 2432 of August (Fritzsche).

537.311.33 : 546.561-31 **3594**

The Semiconductor Properties of Cu_2O: Part 10 — Observations of the Electrical Conductivity when the Thermodynamic Equilibrium is disturbed between 600°C and 1 000°C inside and outside the Cu_2O Stability Region.—G. Blankenburg. (*Ann. Phys., Lpz.*, 13th June 1954, Vol. 14, Nos. 6/8, pp. 290–307.) Part 9: 3593 above.

537.311.33 : 546.561-31 **3595**

The Semiconductor Properties of Cu_2O: Part 11 — The Characteristics of Cu_2O in the CuO Stability Region.—G. Blankenburg. (*Ann. Phys., Lpz.*, 13th June 1954, Vol. 14, Nos. 6/8, pp. 308–318.) Part 10: 3594 above.

537.311.33 : 546.561-31 **3596**

Effect of Electric Field on Absorption Spectrum of Copper Oxide at Low Temperatures.—A. A. Kalinyak & L. G. Fedorovich. (*C. R. Acad. Sci. U.R.S.S.*, 21st June 1954, Vol. 96, No. 6, pp. 1137–1138. In Russian.) Photographs taken at field strengths up to 50 kV/cm at a temperature of 77·3°K show new absorption lines at 5 753 and 5 779 Å. The nature of these is briefly discussed.

537.311.33 : 546.561-31 **3597**

The Copper-Oxide Contact Layer.—A. I. Andrievski & M. T. Mishchenko. (*Zh. tekh. Fiz.*, May 1954, Vol. 24, No. 5, pp. 818–825.) The forming of an intermediate layer between the Cu specimen and the Cu_2O surface layer obtained by oxidizing Cu at ∼ 1 000°C, and the effect of heating time and of impurities on the structure, were investigated experimentally. The microphotographs shown are discussed.

537.311.33 : 546.683 **3598**

The Effect of Thermally Produced Lattice Defects on the Electrical Properties of Tellurium.—S. Tanuma. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, April 1954, Vol. 6, No. 2, pp. 159–171.) The electrical properties are investigated assuming excess holes in the valence band due to electron trapping by the lattice defects. The width of the forbidden energy band is found to be $(0{\cdot}32 + 1{\cdot}9 \times 10^{-4}T)$ eV, the effective masses of electrons and holes are $0{\cdot}68\,m$ and $0{\cdot}91\,m$ and the carrier mobilities due to lattice scattering are 6·1 and $2{\cdot}8 \times 10^6\ T^{-3/2}$ cm/s per V/cm respectively. The sign reversal of the Hall effect and of the thermoelectric power at increased temperature is explained.

537.311.33 : [621.314.632 + 621.316.86 **3599**

Theories of Semiconductor Systems, Rectifiers and Complexes, in the Light of Recent Research.—S. Teszner. (*Rev. gén. Élect.*, June 1954, Vol. 63, No. 6, pp. 319–334.) Failure of the theories of various workers to explain the reverse characteristic of the semiconductor rectifier is discussed. Theory given previously by the author (3445 of 1949) is restated and developed in the light of later experimental work. See also 434 of February (Teszner et al.).

537.311.33 : 621.314.7 **3600**

Transistor Electronics: Imperfections, Unipolar and Analog Transistors.—W. Shockley. (*Proc. Instn Radio Engrs, Aust.*, July 1954, Vol. 15, No. 7, pp. 163–173.) Reprint. See 746 of 1953.

537.311.33 : 621.396.822 **3601**

Frequency Dependence of Electron Fluctuation Phenomena in Semiconductors.—K. W. Böer & K. Junge. (*Z. Naturf.*, Nov. 1953, Vol. 8a, No. 11, pp. 753–755.) Measurements on CdS single crystals at frequencies in the range 1 kc/s–2·5 Mc/s gave results which can be expressed approximately by an inverse power law in which the index changes value at a critical frequency. This behaviour is explained on the basis of an equivalent circuit taking account of different conditions at the boundary layer and in the body of the crystal.

537.312.5 : 546.482.21 **3602**

Influence of Temperature and Oxygen on the Build-Up and Decay of the Photoconductivity of CdS Single Crystals.—G. Höhler. (*Ann. Phys., Lpz.*, 13th June 1954, Vol. 14, Nos. 6/8, pp. 426–427.) Comments on 1478 of May (Seraphin).

538.221 **3603**

Calculations of the First Ferromagnetic Anisotropy Coefficient, Gyromagnetic Ratio and Spectroscopic Splitting Factor for Nickel.—G. C. Fletcher. (*Proc. phys. Soc.*, 1st June 1954, Vol. 67, No. 414A, pp. 505–519.)

538.221 : 537.311.33 **3604**

Further Experimental Investigations on Some Ferromagnetic Oxidic Compounds of Manganese with Perovskite Structure.—J. Volger. (*Physica*, Feb. 1954, Vol. 20, No. 2, pp. 49–66.) Measurements have been made on polycrystalline substances of the type $La_{1-\delta}Sr_{\delta}MnO_3$ to determine d.c. and a.c. resistivity, their variation with temperature and with applied magnetic field, Seebeck effect and Hall effect. Results support the hypothesis of barrier-layer resistance in ceramic semiconductors. See also 656 of 1951 (van Santen & Jonker).

538.221 : 621.318.134 **3605**

Transient Phenomena in a Ferrite.—S. Matz. (*C. R. Acad. Sci., Paris*, 9th Aug. 1954, Vol. 239, No. 6, pp. 487–488.) The complex permeability of a Ni-Zn ferrite was investigated experimentally over the temperature range from −196° to + 20°C, using frequencies of 100 kc/s to 1 Mc/s and a range of values of the magnetizing field and of the time interval between a demagnetization and establishment of the field. The results are interpreted on the basis of Néel's theory of diffusion after-effect.

538.221 : 621.318.134 **3606**

Spontaneous Magnetization as a Function of Temperature for Mixed Crystals of Ferrites with Several Curie Temperatures.—K. F. Niessen. (*Philips Res. Rep.*, June 1954, Vol. 9, No. 3, pp. 197–208.) A method of calculation is demonstrated.

538.221 : 621.318.134 **3607**

Low-Loss Ferrites for Applications at 4 000 Megacycles per Second.—L. G. Van Uitert, J. P. Schafer & C. L. Hogan. (*J. appl. Phys.*, July 1954, Vol. 25, No. 7, pp. 925–926.) Faraday-rotation and loss curves are presented for three MgAlMn ferrites. Rotations exceeding 500° per decibel absorbed can be achieved at 4 kMc/s.

538.221 : 621.318.134 **3608**

Some Physical Properties of Ferrites.—H. P. J. Wijn. (*Onde élect.*, May 1954, Vol. 34, No. 326, pp. 418–424.) Review of properties of ferrites and ferrite powders with reference to their application at r.f. Permeability and magnetization as functions of frequency, and strong-field magnetization curves of a typical soft ferrite are discussed. By covering a ferrite ring while hot with a coat of glass having a higher coefficient of expansion, the ring is compressed on being cooled, and a rectangular hysteresis loop is obtained.

538.24 **3609**

Theory of the Dependence of Spontaneous Magnetization of Metals and Alloys on Temperature in the Low Temperature Region.—E. Kondorski & A. Pakhomov. (*C. R. Acad. Sci. U.R.S.S.*, 21st June 1954, Vol. 96, No. 6, pp. 1139–1142. In Russian.) Metals and binary alloys with a poorly conducting ferromagnetic lattice are considered. Simple formulae for the temperature dependence are derived for particular cases of cubic lattices of the type NaCl, CsCl and $FeNi_3$.

548.7 : 549.514.51 : 621.372.412 **3610**

The Pile Irradiation of Quartz Crystal Oscillators.—F. B. Johnson & R. S. Pease. (*Phil. Mag.*, June 1954, Vol. 45, No. 365, pp. 651–654.) 7-Mc/s BT-cut oscillators were exposed to pile radiation; graphs of frequency-variation/megawatt-hours-irradiation for low and high doses are presented. Two types of effect can be distinguished, due to (*a*) displacements of atoms, and (*b*) ionization.

621.3 : 666.3/.7 **3611**

Ceramic Materials: Technical and Bibliographical Survey.—J. Suchet. (*Onde élect.*, May 1954, Vol. 34, No. 326, pp. 460–470.) Review of development with reference to chemical composition, molecular structure, properties and applications of ceramic insulators, ferroelectric materials, ferrites and semiconducting ceramics. 85 references.

621.315.61 : 621.359.3 **3612**

Magnetic Cores of Broadband Transformer Insulated by Cataphoresis.—H. Sato, S. Kato & T. Shibayama. (*Rep. elect. Commun. Lab., Japan*, April 1954, Vol. 2, No. 4, pp. 13–17.) Digest of paper published in *Monthly J. elect. Commun. Lab., Japan*, 1954, Vol. 7, No. 1. The thin layer of insulation required on transformer-core tapes is produced by electrical precipitation of charged particles from a suspension. The best insulation of 79-Mb permalloy tape, about 0·05 mm thick, was obtained by deposition of MgO from a solution of 400 g MgO in 8 litres of methyl alcohol with 5 cm³ of 60% HNO_3 added, using a voltage ~ 4 V and current ~ 90 mA with tape-speed ~ 2 m/min. Results obtained with Al_2O_3, SiO_2 and porcelain clay are also given.

MATHEMATICS

51(083.5) **3613**

Royal Society Depository for Unpublished Mathematical Tables.—(*Phil. Mag.*, June 1954, Vol. 45, No. 365, pp. 599–609.) A list of tables accepted up to the end of 1953 together with a brief description of each. The tables may be consulted in the Royal Society library and photocopies can be obtained.

517.6 **3614**

Evaluation of the Exponential Integral for Large Complex Arguments.—J. Todd. (*J. Res. nat. Bur. Stand.*, June 1954, Vol. 52, No. 6, pp. 313–317.) Two methods of effecting this evaluation are discussed. It is shown that the Laguerre quadrature method is more effective than the asymptotic expansion. The practicability of the Laguerre method is illustrated by examples.

529.786 + 621.3.018.41] (083.74) **3615**

The Need for a New Type of Frequency and Time Standard.—W. D. George. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, p. 1349.) The distinction between defining and operational standards is indicated, and the shortcomings of standards at present used for time and frequency are emphasized. In the present state of physical knowledge, the appropriate standard is the period of a molecular, atomic or nuclear vibration. It is imperative that a number of atomic clocks should be built and observed and efforts made to obtain agreement and reproducibility to at least one part in 10^9.

529.786 **3616**

Simple Quartz-Tuning-Fork [controlled] **Clocks.**—L. D. Bryzzhev & V. N. Titov. (*Zh. tekh. Fiz.*, May 1954, Vol. 24, No. 5, pp. 879–883.) Description, including dimensions of quartz tuning fork, details of thermostatic control and complete circuit diagrams, of control unit giving 100- and 1 000-c/s continuous sine-wave output and pulses at 1-sec intervals. The r.m.s. frequency error is $\pm 1{\cdot}3 \times 10^{-8}$. The diurnal clock error, which is mainly due to instability of the synchronous-motor-operated relay, is $\sim \pm 0{\cdot}0029$ sec.

531.76 : 621.318.57 : 621.383 **3617**

Measurement of Short Time Intervals using a Trigger Circuit controlled by Two Photocells.—H. Fark. (*Frequenz*, June 1954, Vol. 8, No. 6, pp. 193–195.)

621.3.018.41(083.74) : 621.372.412 **3618**

First Results with the New Frequency Standards of the National Electrotechnical Institute 'G. Ferraris'.—M. Boella. (*Ricerca sci.*, June 1954, Vol. 24, No. 6, pp. 1196–1203.) Observations are reported on the first two examples of a new type of quartz-crystal 100-kc/s oscillator.

621.3.018.41(083.74) : 621.372.412 **3619**

High-Frequency Crystal Units for Primary Frequency Standards.—A. W. Warner. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, p. 1452.) Using design principles previously described (3481 of 1952) a quartz crystal has been produced having a diameter of 100 mm and a thickness of 18 mm and operating at about 1 Mc/s on the eleventh overtone; the unit has a measured Q of 12×10^6.

621.317.33.029.62 : 537.562 **3620**

Measurement of the Conductivity of a Jet Flame.—F. P. Adler. (*J. appl. Phys.*, July 1954, Vol. 25, No. 7, pp. 903–906.) A measurement method previously described (875 of 1950) was used to determine the complex conductivity of a rocket exhaust flame at a frequency of 200 Mc/s. During steady running of the rocket motor a representative value is 2×10^{-5} mho/m; the attenuation of a radio wave in a homogeneous ionized medium with this value of conductivity would be 0·033 db/m. Somewhat higher values are observed during the starting-up period. Sodium impurities in the fuel affect the results greatly.

621.317.335.029.63/.64 **3621**

A New Method of Measurement of the Microwave Complex Dielectric Constant of Liquids.—C. Brot. (*C. R. Acad. Sci., Paris*, 30th Aug. 1954, Vol. 239, No. 9, pp. 612–613.) A method applicable to liquids with low and medium losses is based on determination of the s.w.r. when a section of waveguide filled with the liquid has its length adjusted from a nonresonant to a resonant condition by shifting a short-circuiting piston.

621.317.337 **3622**

The Correction of Q Meter Readings.—J. P. Newsome. (*Electronic Engng*, Sept. 1954, Vol. 26, No. 319, pp. 408–410.) In h.f. direct Q measurements on large air-cored coils and coils using dust or ferrite cores, the circuit residuals may give rise to errors as great as 20%. A simple and rapid method of correction is presented, making use of plotted correction factors in Q-factor form.

621.317.34.018.75 : 621.315.21 **3623**

Amplitude and Phase Equalizer for Pulse Echo Meters for testing Long-Distance Cables.—G. Comte & M. Bouderlique. (*Onde élect.*, June 1954, Vol. 34, No. 327, pp. 514–516.) In the method described, selective negative feedback is applied in accordance with the echo delay. An experimental unit in use comprises ten amplifier stages in cascade, each designed for equalization over a particular frequency range and controlled by a sawtooth-wave generator synchronized with the main pulse generator.

621.317.353 **3624**

Measurement of Nonlinear Distortion and Reasons for the Divergence of Results obtained by Different Methods.—M. Pokrowsky. (*Onde élect.*, June 1954, Vol. 34, No. 327, pp. 525–533.) Harmonic and two intermodulation methods of measurement are compared. The method recommended by the C.C.I.F. of simultaneous variation of two signal frequencies keeping the difference frequency constant has marked advantages if the response curve under investigation is peaked in the middle of the pass band. Other methods are particularly useful when frequency-response is level and noise level high.

621.317.44 **3625**

Discussion of Current-Sheet Approximations in Reference to High-Frequency Magnetic Measurements.—B. Kostyshyn & P. H. Haas. (*J. Res. nat. Bur. Stand.*, June 1954, Vol. 52, No. 6, pp. 279–287.) Errors in h.f. measurements on specimens made up into toroidal coils, due to neglecting leakage flux and to arbitrary assumptions regarding the location of effective current sheets, are investigated experimentally as a function of permeability, core dimensions, wire spacing and wire size.

621.317.444 **3626**

Development of the Technique of Electronic Fluxgate-Type Magnetometers.—G. D. Palazzi. (*Nuovo Cim.*, 1954, Vol. 11, Supplement No. 3, pp. 521–532.) Instruments developed in the U.S.A., Britain and Italy are discussed and their applications considered.

621.317.72 **3627**

Electric Field Meters.—R. Gunn. (*Rev. sci. Instrum.*, May 1954, Vol. 25, No. 5, pp. 432–437.) Two meters are described, both of the field-mill type, with rotating rod inductor. In the a.c. meter the rod is connected to the grid of a valve with a leak to earth, and the sign of the field is obtained by phase-sensitive rectification using a generator on the same shaft as the rod to provide the reference voltage. In the d.c. meter the rectified inductor currents operate a high-impedance push-pull bridge circuit.

621.317.726 **3628**

A Peak Voltmeter with a Long Time Constant.—L. Medina. (*Aust. J. appl. Sci.*, June 1954, Vol. 5, No. 2, pp. 141–144.) An instrument developed for measurements in connection with h.v. puncture and flash-over tests at mains frequency is described; the discharge time constant is 10 000 sec.

621.317.73.012.11 **3629**

An Automatic Impedance Recorder for X-Band.—W. F. Gabriel. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1410–1421.) Details are given of an instrument which operates over the frequency band 8·4–9·9 kMc/s and with incident power levels from about 20 to 250 mW. It produces an ink graph of impedance or admittance on a standard Smith chart or, for higher accuracy, on an expanded central portion of the chart. The circuit is based on the reflectometer principle.

621.317.733 **3630**

Balancing A.C. Measurement Bridges.—F. J. Vettiner. (*Rev. gén. Élect.*, June 1954, Vol. 63, No. 6, pp. 316–318.) Use of a c.r.o. instead of a galvanometer as indicator enables both amplitude and phase to be balanced rapidly. An instrument is thus obtained which has a sensitivity sufficiently high for determining the ionization threshold of an insulator.

621.317.755 : 621.314.63 **3631**

Pulsed Curve Tracer for Semiconductor Testing.—J. I. Pankove. (*Electronics*, Sept. 1954, Vol. 27, No. 9, pp. 172–173.) A circuit is described which provides sawtooth voltage pulses of amplitude 350 V and duration 80 μs at intervals of 4·4 ms; a second sawtooth component of amplitude 100 V and duration $\sim$ 144 ms can be superposed. The arrangement is used for obtaining reverse I/V characteristics of crystal diodes without producing excessive heating.

621.317.761 + [621.396.712 : 621.396.66 **3632**

Frequency and Common-Wave Measurements at the Wittsmoor Transmission-Monitoring Station.—Ehlers & Thies. (See 3680.)

621.385.001.4 : 533.59 **3633**

New Method of Measuring Vacuum Factor of Vacuum Tubes in General.—Sato & Ishii. (See 3719.)

621.397.62.001.4 **3634**

Measurements on Television Receivers: Part 4—Methods for Measurement of Transmission Properties of I.F. Amplifier and H.F. Stages.—O. Macek. (*Arch. tech. Messen*, June 1954, No. 221, pp. 125–128.) Part 3: 3376 of November.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

531.768 : 546.431.823-31 **3635**

A Wide-Range Barium-Titanate Accelerometer.—(*Tech. News Bull. nat. Bur. Stand.*, June 1954, Vol. 38, No. 6, pp. 88–90.) The NBS-33-14 accelerometer, designed for a special military application, has a range of 50 000 g and a natural frequency of 90 kc/s. It uses two barium-titanate ceramic disks separated by a brass disk which acts both as spacer and as electrode. A low noise level is achieved by shielding the disks with a thick dural cup.

535.37 : 621.327 **3636**

The Electroluminescent Lamp: a New Light Source.—K. H. Butler, C. W. Jerome & J. F. Waymouth. (*Elect. Engng, N.Y.*, June 1954, Vol. 73, No. 6, pp. 524–528.) Possible electroluminescence mechanisms are discussed, characteristics of electroluminescent lamps are presented, and three fields of application are mentioned.

621.3.078 : 061.3(47) **3637**

Second All-Union Conference on the Theory of Automatic Regulation.—B. N. Petrov & B. N. Naumov. (*Bull. Acad. Sci. U.R.S.S., tech. Sci.*, Feb. 1954, No. 2, pp. 117–122. In Russian.) This report on the conference held in Moscow in 1953 includes brief notes on the 80 or so papers presented and on the exhibition of models and ancillary apparatus.

621.365.55† **3638**

Calculation of the Temperature Distribution in H.F.-Heated Laminated Materials.—A. V. Netushil. (*Zh. tekh. Fiz.*, June 1954, Vol. 24, No. 6, pp. 1035–1040.) The application of the derived formulae and tabulated data is illustrated by a numerical calculation of the temperature difference between wood and glue stacked with the laminations perpendicular to the plane heater electrodes. A field strength of 0·5 kV/cm and a frequency of 25 Mc/s are assumed in the calculation.

621.369.4 **3639**

Medical Applications of Short-Wave Energy.—W. Kebbel. (*Funk u. Ton*, June 1954, Vol. 8, No. 6, pp. 329–332.) The heating effects in a fat-muscle dummy produced by microwave radiation (λ 12·25 cm) and by h.f. (λ 11·6 m) radiotherapy are briefly compared and an automatic method of regulating output power in the h.f. system is briefly described.

621.383 **3640**

Optical Transducers and some Industrial Applications.—J. A. Sargrove. (*J. Brit. Instn Radio Engrs*, Aug. 1954, Vol.14, No. 8, pp. 337–350.) The transducers discussed are based on photoelectric cells, and include sharp-focus-light-spot types for reflectometers and light-scatter types for nephelometric determinations. Other applications mentioned are high-speed weighing, line-following and edge-alignment equipment.

621.383.27 **3641**

Optar, a Method of Optical Automatic Ranging, as applied to a Guidance Device for the Blind.—H. E. Kallmann. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1438–1446.) Shallow real images of the objects in the explored field are formed in an image space where a helical slotted vane is rotated to cut across all rays in one image plane after another. When the bars coincide with a sharp image they modulate the light received by a photocell. Tones of eight frequencies, corresponding respectively to eight ranges between 20 in. and 20 ft, are produced in earphones. A hand-held model is described.

621.384.6 **3642**

Two Ion Sources for the Production of Multiply Charged Nitrogen Ions.—R. J. Jones & A. Zucker. (*Rev. sci. Instrum.*, June 1954, Vol. 25, No. 6, pp. 562–566.) Hot-cathode and hollow-anode sources for particle accelerators are discussed.

621.384.611/.612 **3643**

Regenerative Deflection as a Parametrically Excited Resonance Phenomenon.—S. E. Barden. (*Rev. sci. Instrum.*, June 1954, Vol. 25, No. 6, pp. 587–593.) Analysis of a particle-extraction method for use with synchrocyclotrons.

621.384.611 **3644**

High-Intensity Ion Source for Cyclotrons.—R. S. Livingston & R. J. Jones. (*Rev. sci. Instrum.*, June 1954, Vol. 25, No. 6, pp. 552–557.) A hot-cathode arc-discharge type of source is described; a current of 3 mA of 22-MeV protons has been obtained from the 86-in. Oak Ridge cyclotron using this source.

621.384.612 **3645**

The Radio-Frequency Fine Structure of the Photon Beam from the Berkeley Synchrotron.—R. Madey, K. C. Bandtel & W. J. Frank. (*Rev. sci. Instrum.*, June 1954, Vol. 25, No. 6, pp. 537–540.)

621.384.612 **3646**

Design Study of a Strong-Focusing Electron-Synchrotron.—E. Smârs & O. Wernholm. (*Ark. Fys.*, 25th March 1954, Vol. 7, Part 5, pp. 463–472.) The design of an electron accelerator based on the principles described by Courant et al. (1454 of 1953) is relatively simple, since it can be arranged that no r.f. modulation is required. The machine is not expected to provide higher energies than the conventional synchrotron, but is useful for studying the strong-focusing principle.

621.384.622 **3647**

Investigation of the Collector Characteristics of the Palletron.—V. K. Shtein. (*Zh. tekh. Fiz.*, June 1954, Vol. 24, No. 6, pp. 1062–1068.) The dependence of the collector current on the amplitude and frequency of the accelerating voltage, on the focusing magnetic-field strength and on the emitter temperature was investigated experimentally and theoretically. The resolving power of a palletron used as mass-spectrometer is inversely proportional to the pulse length. The palletron was described earlier by Skellett (810 of 1949).

621.385.833 **3648**

A Compact Console-Type Electron Microscope.—R. S. Page. (*J. sci. Instrum.*, June 1954, Vol. 31, No. 6, pp. 200–205.) Description of the Type-E.M.4 model, developed for general-purpose routine electron micrography. The mounting of the electron gun is such that reflection-type operation is possible as well as the more usual transmission-type.

621.385.833 **3649**

Relativistic Aberration Functions and Normal Coefficients of Electron-Optical Aberrations.—O. I. Seman. (*C. R. Acad. Sci. U.R.S.S.*, 21st June 1954, Vol. 96, No. 6, pp. 1151–1154.) Relativistic formulae for third-order aberration coefficients are given in terms of the coefficients of the point eikonal in static electric and magnetic fields with rotational symmetry. In particular, formulae are given for Petzval's coefficient, the coefficients of anisotropic coma, astigmatism and distortion, spherical aberration, coma, curvature and distortion. The relativistic coefficients reduce to ordinary ones at low energies.

621.385.833 **3650**

Effect of Departures from Rotational Symmetry of the Focusing Field on the Resolution of Magnetic Objectives in Electron Microscopes.—G. V. Der-Shvarts. (*Zh. tekh. Fiz.*, May 1954, Vol. 24, No. 5, pp. 859–870.) The effects on the vector potential and induction vector components are calculated for (*a*) ellipticity of field boundaries, (*b*) displacement of axes of symmetry of lens components relative to each other, and (*c*) tilt of lens axes relative to each other or of the axis of symmetry of the lens system relative to the optic axis. The relations between the geometry of the system and coma and astigmatism (down to the order of 35 Å and less) are discussed.

621.385.833 **3651**

Electron-Optical Properties of Electrostatic Lenses: Part 3.—W. Lippert & W. Pohlit. (*Optik, Stuttgart*, 1954, Vol. 11, No. 4, pp. 181–186.) Continuation of investigation of unipotential lenses. Part 2: 1158 of April.

621.385.833 **3652**

A Low-Distortion Electromagnetic Double Projection Lens for Electron Microscopes.—L. Wegmann. (*Optik, Stuttgart*, 1954, Vol. 11, No. 4, pp. 153–170.) The condition for minimal radial aberration is derived in terms of the focal lengths of the two electromagnetic lenses ,comprising the projection-lens system. The magnification range of 1 : 3 is achieved using simple control circuits without valves.

621.385.833 **3653**

Shadowing Technique for Electron Microscopy — a Possible Substitute for the High-Vacuum Evaporation Technique.—A. E. Bills & R. Lefker. (*J. appl. Phys.*, July 1954, Vol. 25, No. 7, pp. 901–903.)

621.385.833 **3654**

Design of a Slotted Electron Lens for Analysis of [electron] **Velocities.**—A. Septier. (*C. R. Acad. Sci., Paris*, 2nd Aug. 1954, Vol. 239, No. 5, pp. 402–404.) Calculations for a cylindrical lens are presented.

621.385.833 **3655**

Development of an Electrostatic Spectrograph from an Electron Microscope.—B. Gauthé. (*C. R. Acad. Sci., Paris*, 2nd Aug. 1954, Vol. 239, No. 5, pp. 399–402.) The cylindrical lens described by Septier (3654 above) is used in an instrument for determining the distribution of electron velocities in a beam.

621.385.833 : 535.215 **3656**

Experimental Photoemission-Type Electron Microscope—E. L. Huguenin. (*C. R. Acad. Sci., Paris*, 2nd Aug. 1954, Vol. 239, No. 5, pp. 404–406.) A 20-kV two-stage e.s. instrument is discussed in which an image is formed of a surface which emits electrons when subjected to ultraviolet radiation; the object is illuminated at nearly grazing incidence by an Hg-vapour lamp. A directly viewed fluorescent screen was used in the first experiments; this was later replaced by a screen/camera unit.

621.385.833 : 535.767 **3657**

Theory and Technique of Electron-Microscope Stereograms.—J. G. Helmcke. (*Optik, Stuttgart*, 1954, Vol. 11, No. 5, pp. 201–225.) Relations between the stereo shift angle, depth of object, microscope magnification and optical data of the viewing system necessary for satisfactory production and reproduction of stereoscopic images are discussed.

621.385.833.013.001.57 **3658**

Measuring Magnetic Fields [of electron-microscope lenses] **on Scale Models, taking account of Saturation Phenomena.**—G. Langner & F. Lenz. (*Optik, Stuttgart*, 1954, Vol. 11, No. 4, pp. 171–180.)

621.387.4 **3659**

Instruments for Radiation Protection.—R. B. Stephens. (*J. Brit. Instn Radio Engrs*, Aug. 1954, Vol. 14, No. 8, pp. 377–386.) Design principles are discussed with special reference to reliability, ease of handling and simplicity of control. The influence of these features on the design of a hand and foot monitor and a Civil Defence contamination meter is considered.

621.39 : 622.323 **3660**

Electronics in the Oil Industry.—J. M. Carroll. (*Electronics*, Sept. 1954, Vol. 27, No. 9, pp. 120–127.) Methods used in geophysical prospecting and other operations connected with various aspects of the petroleum industry are discussed. Extensive microwave radio communications have been developed for pipeline systems. Measurement and control of temperature, pressure, rate of flow and liquid level in the refining process are among the operations that can be performed electronically.

681.142 : 629.13 **3661**

Analogue Computers in Aircrew Training Apparatus.—Cutler. (See 3477.)

PROPAGATION OF WAVES

538.566 **3662**

On the Theory of Propagation of Electric Waves over a Plane Surface of the Homogeneous Earth (On Sommerfeld's Surface Waves).—Y. Nomura. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, Dec. 1953/March 1954, Vol. 5, Nos. 3/4, pp. 203–214.) Results of a calculation by the saddle-point method show that Sommerfeld's surface-wave term due to the residue at the pole of the integrand is just cancelled by the part of the integral along the steepest descent through the saddle point, and the remaining part of the integral gives van der Pol & Niessen's formula, which is an extension of Weyl's solution.

538.566 **3663**

Energy Correlations in Space-Dispersive Media.—M. E. Gertsenshtein. (*Zh. eksp. teor. Fiz.*, June 1954, Vol. 26, No. 6, pp. 680–683.) Rytov's results (1720 of 1948) are generalized to include the case of a medium with nonuniform dielectric constant; it is shown that the velocity of propagation of energy is equal to the group velocity.

621.396.11 **3664**

Difficult Predictions discussed at the C.C.I.R., 1953. Circuits linking Australia to Canada and Great Britain.—R. Gea Sacasa. (*Rev. Telecomunicación, Madrid*, June 1954, Vol. 9, No. 36, pp. 2–16. In Spanish and English.) Further demonstration of the success of the 'Spanish method' for predicting propagation conditions. See also 2493 of August and back references.

621.396.11 : 551.510.535 **3665**

The Quality of Radio Weather.—B. Beckmann. (*Fernmeldetech. Z.*, June 1954, Vol. 7, No. 6, pp. 285–301.) 'Radio weather' is defined as the sum of the effects of ionospheric conditions on the propagation conditions along a radio circuit. The construction of clock-face charts using the product of usable bandwidth and mean received field strength as criterion of radio-weather quality (2417 of 1953) is described. These charts, based on monthly mean figures, serve as comparison standards for demonstrating seasonal and sunspot-cycle variations. Fundamental differences between various over-sea circuits, depending on the location of the path in relation to the sun, are indicated.

621.396.11.029.6 **3666**

Current Problems in the Study of U.S.W. Transmission.—J. Voge. (*Onde élect.*, June 1954, Vol. 34, No. 327, pp. 487–498.) A review of recent data on (*a*) propagation at v.h.f. over distances of 1 000–2 000 km by ionospheric scattering [2581 of 1952 (Bailey et al.)]; (*b*) tropospheric propagation at 40–4 000 Mc/s over distances up to 1 000 km; (*c*) u.h.f. fading on line-of-sight transmission paths, which is dealt with in greater detail. 48 references.

621.396.11.029.62 **3667**

Scattered Reflections in Short-Wave Propagation.—H. A. Hess. (*Funk u. Ton*, June 1954, Vol. 8, No. 6, pp. 283–287.) Previously reported results (e.g. 3496 of 1948) are discussed in the light of later work on long-distance v.h.f. propagation and on backscatter.

621.396.81 **3668**

Theoretical Field Strengths and Angles of Incidence of WWV Transmissions at the Châtonnaye Receiving Station.—C. Glinz. (*Tech. Mitt. schweiz. Telegr.-Teleph Verw.*, 1st June 1954, Vol. 32, No. 6, pp. 222–237. In French.) Calculations are made of the angles of incidence for the transmissions at 2·5–35 Mc/s, assuming the space wave to make two or more hops between the earth and the F_2 layer. December 1948 and June 1949 are chosen as representative periods and 0300 and 1500 GMT as representative times. Different values of the height of the F_2 layer are considered. The question of m.u.f. is examined in detail. Corrections are made for the transmitter and receiver radiation diagrams [1912 of 1953 (Dufour)] and for variations of power level. Field strengths are predicted as 90%, 50% and 10% probabilities. Agreement with values observed by Ebert (1476 of 1951) is satisfactory.

621.396.8!2.3.029.64 **3669**

Microwave Fading.—S. Matsuo, S. Ugai, K. Kakita, F. Ikegami & Y. Kono. (*Rep. elect. Commun. Lab., Japan*, Nov. 1953, Vol. 1, No. 3, pp. 38–47.) Analysis of the results of propagation tests at 4 kMc/s made during the last three years with a view to establishing a multichannel relay network. The two types of fading investigated were k-type, defined in terms of the equivalent ground-reflection coefficient, and duct-type. Typical hourly variations of equivalent k-value determined from space- and frequency-diversity records and probable field-strength distribution curves for different values of reflection coefficient are shown. For duct-type fading empirical expressions are given for clearance factor, a function of average path height ($\bar{h}$), and for fading depth. The latter increases as $\bar{h}$ decreases. When $\bar{h}$ is above several hundred metres topography is unimportant, except that strong ducts are formed easily over flat land.

RECEPTION

621.396.62 : 621.396.3 **3670**

New Receivers for Commercial Radio Teleprinter Service.—H. Heuser. (*Fernmeldetech. Z.*, June 1954, Vol. 7, No. 6, pp. 279–280.) Receivers developed in Western Germany, using frequency-shift keying, are described briefly; they are suitable for frequency-diversity or space-diversity operation.

621.396.82 : 621.397.62 **3671**

I.R.E. Standards on Receivers: Methods of Measurement of Interference Output of Television Receivers in the Range of 300 to 10 000 kc/s, 1954.—(*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1363–1367.) Standard 54 I.R.E. 17S1.

621.396.823 : 621.365 **3672**

Testing the Radio-Interference Effect of High-Frequency Heating Equipment.—G. Use. (*Elektrotech. Z., Edn A*, 1st June 1954, Vol. 75, No. 11, pp. 357–362.) A summary of West German radio-interference-suppression regulations for medical and industrial h.f. apparatus, covering the range from 10 kc/s to 3 000 kMc/s, is followed by a description of the method of field-strength measurement in the range 150 kc/s–470 Mc/s with particular attention to the range 30–400 Mc/s. The correction factor for field strengths measured near the ground, with the standard set-up, and the maximum permissible field strength at various distances from the interference source are shown graphically. The production of equipment complying with the regulations was shown to be technically and economically possible for the majority of the 144 different types of apparatus tested.

STATIONS AND COMMUNICATION SYSTEMS

621.376.5 **3673**

Notes on Pulse Delta Modulation.—R. Stampfl. (*Öst. Z. Telegr. Teleph. Funk Fernsehtech.*, May–Aug. 1954, Vol. 8, Nos. 5–8, pp. 58–63 & 92–97.) Principles of the

technique are described and the design of a delta-modulation system is discussed taking account of normal quantization noise and the impossibility of obtaining perfect equality between the positive and negative difference steps. A detailed description is given of the design of an experimental coding unit.

621.39.001.11 **3674**

Coding for Constant-Data-Rate Systems: Part 1—A New Error-Correcting Code.—R. A. Silverman & M. Balser. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1428–1435.) "A study of coding to reduce the frequency of errors in communication systems which transmit data at a constant rate has been started. A new single-error-correcting code (the Wagner code) is described and analyzed. Its performance in a constant-data-rate system is evaluated and compared with Hamming's single-error-correcting code. The Wagner code is superior for many communication applications. Its successful implementation does not require too precise equipment."

621.39.001.11 **3675**

The Entropy of the German Language.—K. Küpfmüller. (*Fernmeldetech. Z.*, June 1954, Vol. 7, No. 6, pp. 265–272.) From the known frequency of occurrence of the letters, syllables and words in written German, combined with experimental investigations of the superfluous elements, the entropy is found to be 1·6 bits/letter, or 1·3 bits/symbol, including the space between words as one symbol. This value is of the same order as that found by Shannon for written English (1649 of 1949). The information rate of spoken German was found to range from 24 to 54 bits/sec. .

621.396.4.029.63/.64 **3676**

Industry Co-ordination of Microwave Communications Systems.—V. J. Nexon. (*Elect. Engng, N.Y.*, June 1954, Vol. 73, No. 6, pp. 537–540.) Discussion of problems encountered in areas of the U.S.A. where large and growing numbers of microwave radio communication systems are operating. Adequate surveys must be made before designing new systems if space and frequency congestion are to be avoided. Channel 'packaging', frequency stability and beam-width tolerances are considered.

621.396.41 **3677**

Methods of Synchronization and Distribution in Time-Division Multiplex Systems.—I. Incollingo. (*Onde élect.*, May 1954, Vol. 34, No. 326, pp. 431–440.) Synchronizing methods are classified into two groups according as the synchronizing signal does or does not occupy part of the frequency band used for transmitting intelligence. Principles of the methods are described including, in the second group, use of auxiliary modulation, of pulse clipping and of panoramic receivers.

621.396.5 : 621.396.65.029.62 **3678**

Radiotelephony Links of the Kraftwerke Oberhasli A.G.—H. Stalder. (*Bull. schweiz. elektrotech. Ver.*, 26th June 1954, Vol. 45, No. 13, pp. 543–546.) Description of installations for communications in mountainous country, especially for use during the building of new power stations. Frequencies in the 8-m waveband were used for links in which propagation was effected by reflection from the sides of the mountain, while frequencies in the 1·8-m waveband were used for a link parallel with a valley.

621.396.5 : 621.396.721.029.62 **3679**

Harbor Services: Radio Telephone Equipment.—F. Iwai & T. Morinaga. (*Rep. elect. Commun. Lab., Japan*, Dec. 1953, Vol. 1, No. 4, pp. 4–9.) The equipment operates in the frequency band 162–172 Mc/s. At the base station are two 40-W ph.m. transmitters mounted in the same bay, and two double-superheterodyne receivers, i.f. 5·5 Mc/s and 455 kc/s. The aerial system is a vertical-dipole array with a curtain-type reflector and cavity-resonator diplexing arrangements. Details are given of operating characteristics. 5-W transmitter/receivers are used for mobile units.

621.396.712 : 621.396.66] + 621.317.761 **3680**

Frequency and Common-Wave Measurements at the Wittsmoor Transmission-Monitoring Station.—H. Ehlers & H. Thies. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1954, Vol. 6, Nos. 3/4, pp. 57–66.) An account is given of the work of the station at Wittsmoor near Hamburg. The method of monitoring N.W.D.R. transmissions on frequencies up to 100 Mc/s is described in detail. Temperature and humidity-controlled 100-kc/s standard quartz oscillators are used to supply the operational frequencies of 1, 10, 100 and 1 000 kc/s; the accuracy of the oscillators is checked against the standard frequency transmissions of MSF, WWV and other time-signal sources. A precision frequency meter for measurements up to 600 Mc/s is also briefly described.

621.396.712.2/.3 : 534.8 **3681**

The Acoustical Design of a New Sound Broadcasting Studio for General Purposes.—Humphreys. (See 3441.)

621.396.93 **3682**

Design, Planning and Operation of Mobile Communication Systems.—(*Trans. Inst. Radio Engrs*, June 1954, No. PGVC-4, pp. 1–98.) The text is given of nine papers presented at a meeting in November 1953, dealing with mobile radio communication systems for various special purposes.

621.396.945 **3683**

Radio Experiments in Mines.—C. Berthold. (*NachrTech.*, May 1954, Vol. 4, No. 5, pp. 218–223, 239.) Report of experimental investigation of communication at frequencies between 20 kc/s and 100 Mc/s. Results show that the optimum frequency range is from 110 kc/s to 150 kc/s. Various aerials were used in conjunction with the 10-W (max) transmitter and the receiver. Field-strength measurements were made for several transmitter and receiver positions, and the wave-guiding effect of conductors was noticed. A short summary of similar investigations in the U.S.A., South Africa and elsewhere is given.

SUBSIDIARY APPARATUS

621-526 **3684**

The Frequency Response of a Certain Class of Non-Linear Feedback Systems.—J. C. West & J. L. Douce. (*Brit. J. appl. Phys.*, June 1954, Vol. 5, No. 6, pp. 204–209.) A method is described for predicting the frequency response of feedback systems including one single-valued nonlinear element followed by a low-pass filter. The conditions giving rise to gain discontinuity, or 'jump' phenomenon, are investigated. Experimental results obtained with an electronic servo simulator justify the use of the analytical technique.

621-526 : 621.396.662 **3685**

Remote Control of Radio Receivers.—C. E. Tate. (*Wireless World*, Oct. 1954, Vol. 60, No. 10, pp. 496–498.) A zero-seeking-servo tuning control designed for operation over a single Post Office telephone line is

described, the signal from the tuned receiver passing along the control lines. Maximum separation is seven loop-miles for underground routes or 20–30 loop-miles for overhead routes, depending on the type of cable. The circuit is essentially a Wheatstone bridge with two variable arms, one of which is carried to the remote point along the line. The detector comprises a second-harmonic magnetic modulator combined with valve amplifier.

621.311.6 **3686**

A Stable D.C. Source of Low Voltage with Low Internal Resistance.—W. R. Beakley. (*J. sci. Instrum.*, June 1954, Vol. 31, No. 6, pp. 219–220.) A mains-driven source providing a direct voltage of 2·6 V constant to within ±0·1% for mains voltage variations of ±15% and current drain of 5–9 mA uses a magnetic amplifier as an impedance transformer to provide a very low output resistance from a gas-filled reference tube Type 85A2. Long-term stability depends mainly on the reference tube, which has a nominal drift of 0·1% per 1 000 h after an aging period.

621.311.6 **3687**

The Design of High-Efficiency Radio-Frequency E.H.T. Supplies.—J. Barron. (*Electronic Engng*, Sept. 1954, Vol. 26, No. 319, pp. 393–396.) Difficulties associated with the use of air-cored step-up transformers for the production of high voltages are discussed. Designs in which these difficulties are eliminated or alleviated are obtained by using transformers with ferroxcube cores. Simple design procedure is outlined, with numerical examples.

621.311.6 : 621.383.27 **3688**

A Current Stabilized Photomultiplier Power Supply.—P. Fellgett. (*J. sci. Instrum.*, June 1954, Vol. 31, No. 6, pp. 217–219.) Stabilization is based on the series connection of two cathode followers. Tests on the circuit are reported; voltage is maintained constant to within one part in 10^4.

621.314.634 **3689**

Selenium Rectifier Disks as Voltage-Dependent Resistors for Amplification of Fluctuations of a Component Voltage and Voltage Stabilization, particularly Amplitude Limiting.—E. Hesse. (*Frequenz*, June 1954, Vol. 8, No. 6, pp. 177–180.)

621.314.634 **3690**

Investigation of Rectification Properties of Se-HgSe Contact.—A. F. Belski & A. I. Blum. (*Zh. tekh. Fiz.*, May 1954, Vol. 24, No. 5, pp. 826–832.) The experimentally determined rectification-coefficient maximum, occurring at ~ 2 V, is ~ 10 for 97% pure Se, and ~ 7 for 99·99% Se. Current/voltage characteristics were investigated for rectifiers with the HgSe prepared by exposing Se to Hg vapour or to liquid Hg, Se crystallized at various rates and temperatures, various electrode base materials and Se of two different grades of purity. The results are shown graphically.

621.314.634 **3691**

Asymmetry in Conductivity of Some Selenides.—N. G. Klyuchnikov. (*Zh. tekh. Fiz.*, May 1954, Vol. 24, No. 5, pp. 833–836.) The experimentally determined current/voltage characteristics of a CuSe-Mg rectifier are discussed. The ratio of reverse to forward current varies between 1 : 4000 and 1 : 6000, the power-handling capacity is ~ 0·7–0·8 W/cm² and the blocking layer is stable even at 200°–300°C. The principal disadvantages of this rectifier are the large hysteresis effect and the de-forming after prolonged storage. Other selenides and selenide/metal combinations are briefly noted.

TELEVISION AND PHOTOTELEGRAPHY

621.397.2 **3692**

Multiplex Television Transmission.—J. Haantjes & K. Teer. (*Wireless Engr*, Sept. & Oct. 1954, Vol. 31, Nos. 9 & 10, pp. 225–233 & 266–273.) "Systems for the transmission of several television signals within a single television channel are described in this article; they are based on the use of signal components which cancel out in two successive pictures. A distinction is made between the sub-carrier and the dot-interlace systems. The typical characteristics of both systems are determined and, in particular, those characteristics which affect the separation of the signals at the receiver. Their application to colour television is considered and the conclusion is drawn that for this the sub-carrier system is to be preferred."

621.397.26 : 621.396.65 **3693**

Equipment of the Berlin-Leipzig Television Link.—W. Mansfeld. (*NachrTech.*, May 1954, Vol. 4, No. 5, pp. 194–196.) Description with block diagrams and performance data of 1·5-kMc/s f.m. equipment Type-KVG 904. At the relay station amplification is effected at 60 Mc/s before retransmission at u.h.f. Transmitter output is 8 W. See also 2782 of September (Megla).

621.397.26 : 621.396.65.029.62 **3694**

Television Link between Germany and Switzerland.—G. Mahlow. (*Funk-Technik, Berlin*, June 1954, Vol. 9, No. 11, pp. 290–291.) Description of equipment for a temporary u.s.w. link between Hornisgrinde (Schwarzwald) and Chasseral (Jura) in connection with the European television exchange programmes. The Hornisgrinde station operates in the 174–216-Mc/s band and is just within line of sight of Chasseral. The highly directive dipole array has a gain of 204, and the 1-kW transmitter is modulated at low level.

621.397.5 : 778.5 **3695**

New 35-mm Single-Film-System Kinescope Recording Camera.—R. M. Fraser. (*J. Soc. Mot. Pict. Telev. Engrs*, June 1954, Vol. 62, No. 6, pp. 441–449. Discussion, p. 449.)

621.397.61 **3696**

The Specification of Imaging Properties by Response to a Sine Wave Input.—J. W. Coltman. (*J. opt. Soc. Amer.*, June 1954, Vol. 44, No. 6, pp. 468–471.) The response of an optical system to a 'sine-wave' test pattern constitutes a convenient criterion for assessing its imaging properties. A simple formula is given for calculating the response to the 'sine-wave' pattern from the response to the usual 'square-wave' (bar) pattern. The responses of individual parts of a system, such as a fluoroscope or television camera, can be readily combined to give the overall response.

621.397.61 : 621.396.67 **3697**

The Impedance Specification of a Television Transmitting Aerial.—Page. (See 3460.)

621.397.62 + 621.396.62.029.62 **3698**

Television Receiver 'Sever'.—M. Tovbin. (*Radio, Moscow*, June 1954, No. 6, pp. 43–47.) Description, including complete circuit diagram, of a Russian-made receiver covering three pre-set television v.h.f. channels and the 66–73-Mc/s f.m. broadcast band. This receiver is also known by the name 'Zenit'.

621.397.62 : 535.623 **3699**

Modified Color Signal for Single-Gun Tubes.—S. K. Altes & A. P. Stern. (*Electronics*, Sept. 1954, Vol. 27, No. 9, pp. 168–170.) The N.T.S.C. signal, as it appears at the second detector of the receiver, is of dot-sequential type but represents a combination of the three primary colours. Techniques are described for separating out the three colour signals, while retaining the dot-sequential nature, so as to make the signal suitable for a single-gun rather than a three-gun tube. Modification of the sinusoidal waveform used for colour switching is involved.

621.397.62 : 535.623 **3700**

Significance of Some Receiver Errors to Color Reproduction.—H. Weiss. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1380–1388.) A method is described for determining the significance of various types of signal error in terms of colour perception by an observer. Deviations in chromaticity are evaluated in terms of MacAdam's unit of equal noticeability (2553 of 1951). An experimental investigation of viewer tolerances is reported.

621.397.62 : 535.623 **3701**

The Design of I.F. Amplifiers for Color Television Receivers.—J. Avins. (*Trans. Inst. Radio Engrs*, July 1954, No. PGBTR-7, pp. 14–25.) The principal design problem is that of providing adequate rejection at the frequency of the sound carrier without introducing excessive delay in the colour sideband region, which is separated from the sound carrier by $< 1\%$ of signal frequency. Non-minimum-phase-shift trap circuits for this purpose are described. See also 1222 of April (Avins et al.).

621.397.62 : 621.396.82 **3702**

I.R.E. Standards on Receivers: Methods of Measurement of Interference Output of Television Receivers in the Range of 300 to 10 000 kc/s, 1954.—(*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1363–1367.) Standard 54 I.R.E. 17S1.

621.397.62 : 621.396.822 **3703**

Detection of Television Signals in Thermal Noise.—J. E. Bridges. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1396–1405.) The detection process is analysed using a method similar to that of Ragazzini (390 of 1943). Because of the complex i.f. response, the noise is represented as the sum of a finite number of sinusoidal components. From this, the (signal + noise) envelope preceding the detector can be determined and thence the r.m.s. noise and signal spectrum following the detector; the signal/noise ratios in any channel following the detector can then be computed. It is shown that with very weak signals the diode detection process suppresses the desired video modulation and, in effect, creates additional noise. Two improved detection circuits, an exalted-carrier i.f. and a product detector, are described.

621.397.62 : 621.385.832 **3704**

The Measurement of Yoke Astigmatism.—R. A. Bloomsburgh. (*Trans. Inst. Radio Engrs*, July 1954, No. PGBTR-7, pp. 26–33.) Distortion of a cathode beam is discussed in terms of optical concepts. Microscope measurements of the spot at different points are used to determine the positions of the foci and hence the characteristics of the deflection yoke. Application of the method to the investigation of three-beam tubes for colour television is described; in this case yoke astigmatism increases with deflection angle more rapidly than in monochrome tubes.

621.397.62.001.4 **3705**

Measurements on Television Receivers: Part 4—Methods for Measurement of Transmission Properties of I.F. Amplifier and H.F. Stages.—O. Macek. (*Arch. tech. Messen*, June 1954, No. 221, pp. 125–128.) Part 3: 3376 of November.

621.397.7 : 534.861 **3706**

Electroacoustic Equipment of the Hamburg-Lokstedt Television Centre.—G. Schadwinkel & F. Naupert. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1954, Vol. 6, Nos. 3/4, pp. 67–70.) An illustrated description of the installation. See also 563–566 of February.

621.397.8 **3707**

Reproduction of Pictures by Inexactly Tuned Television Receivers.—F. Kirschstein & A. Krug. (*Fernmeldetech. Z.*, June 1954, Vol. 7, No. 6, pp. 273–278.) With vestigial-sideband transmission, the i.f. carrier is usually arranged to fall in the middle of the upper slope of the receiver i.f. filter characteristic. Distortion of video components due to faulty adjustment is calculated and investigated experimentally. Oscillograms of rectified test signals and corresponding monitor-tube reproductions of test cards are shown. Suggestions are advanced for eliminating distortion due to the quadrature carrier component by emphasizing the in-phase component at transmitter or receiver.

621.397.82.029.62 **3708**

Band-III Television Interference.—F. R. W. Strafford. (*Wireless World*, Oct. 1954, Vol. 60, No. 10, pp. 501–504.) Differences in the effects of man-made interference on bands I and III are discussed in the light of interference records compiled by the British Post Office. Propagation of interference from fractional-horse-power commutator motors in domestic appliances is considered. Experiments indicate that for interference suppression on band III high-impedance self-resonant inductors should be fitted as close as possible to the motor brushes, within the appliance. A motor with square-section brushes 'bedded in' to the commutator curvature generated much lower interference than a similar motor with circular-section brushes.

TRANSMISSION

621.396.61 : 621.396.8 **3709**

Subjective Investigations of Nonlinear Distortion of Several Transmitters of the N.W.D.R.—E. Belger. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1954, Vol. 6, Nos. 3/4, pp. 80–84.) Measurements similar to those reported by Baer & Lauer (1944 of June) show that the u.s.w. transmitter at Bonn is adjudged both subjectively and objectively to possess better frequency and non-linear distortion characteristics than older medium-wave transmitters of the N.W.D.R. The subjective score marks and the measured frequency and distortion characteristics are given for several transmitters, ranging from good quality to very poor. Fair agreement between subjective and objective results was obtained.

VALVES AND THERMIONICS

621.314.63 **3710**

Charge Storage in Junction Diodes.—E. L. Steele. (*J. appl. Phys.*, July 1954, Vol. 25, No. 7, pp. 916–918.) Formulae are derived for the current spike which occurs, as a result of hole storage in the *n*-type body of a Ge diode, on switching suddenly from forward to reverse conduction. Reduction of hole lifetime and use of thinner Ge pellets tend to reduce the spike and improve the frequency response.

621.314.63 : 621.396.822 **3711**

Flicker Noise in Germanium Rectifiers at Very Low and Audio Frequencies.—D. K. Baker. (*J. appl. Phys.*, July 1954, Vol. 25, No. 7, pp. 922–924.) Measurements on point-contact and alloyed-junction type Ge rectifiers show that flicker noise varies inversely as frequency over the whole range from about 10^{-3} to 10^{6} c/s. The current dependence of the flicker noise at 10 c/s was also investigated.

621.314.632 : 546.289 **3712**

Experimental Results in the Selection of Germanium Rectifiers.—P. Goudal. (*Cah. Phys.*, May 1954, No. 49, pp. 65–66.) Measurements on groups of rectifiers from two different suppliers are reported. In the one group, instability of inverse current was exhibited by several specimens at 24°C and by a larger number at 44°C. The importance of selecting Ge rectifiers with low values of temperature coefficient is emphasized.

621.314.7 **3713**

Steady-State Solution of the Two-Dimensional Diffusion Equation for Transistors.—J. S. Schaffner & J. J. Suran. (*J. appl. Phys.*, July 1954, Vol. 25, No. 7, pp. 863–867.) "The diffusion equation is solved for transistors for (*a*) linear flow of minority carriers and (*b*) non-uniform flow of minority carriers due to a metal contact applied to the base region. The current transport ratio β is calculated for both of these cases as a function of frequency. Frequency response characteristics of a transistor, as predicted by the one-dimensional diffusion equation, give excellent results for junction transistors having base-length-to-base-width ratios greater than 10 and having negligible surface recombination rates. For transistors where these conditions are not applicable, the two-dimensional diffusion equation must be used in the calculation of β."

621.314.7 : 537.311.33 **3714**

Transistor Electronics: Imperfections, Unipolar and Analog Transistors.—W. Shockley. (*Proc. Instn Radio Engrs, Aust.*, July 1954, Vol. 15, No. 7, pp. 163–173.) Reprint. See 746 of 1953.

621.314.7 : 621.373.52 **3715**

Internal Oscillations in Transistors.—H. E. Hollmann. (*Z. Phys.*, 21st June 1954, Vol. 138, No. 1, pp. 1–15.) See 2540 of August.

621.383.5 **3716**

Production of E.M.F. by Illumination of Lead-Sulphide Photoresistors.—R. Ya. Berlaga & L. P. Strakhov. (*Zh. tekh. Fiz.*, May 1954, Vol. 24, No. 5, p. 943.) A brief note. The largest photovoltaic effect was observed in a sample of PbS prepared by evaporation in CO_2 at 0·05–0·1 mm Hg pressure and a temperature of 240°–250°C, then heated at 500°C for 5–10 min. and cooled in vacuo to room temperature. An e.m.f. of ~ 1·2 V was obtained by illuminating with a 100-W lamp. No current was passed through the sample during manufacture. See also Starkiewicz, Sosnowski & Simpson, *Nature*, 6th July 1946, Vol. 158, No. 4001, p. 28.

621.385 **3717**

Some Factors affecting Transmitting-Valve Life.—T. N. Basnett. (*Proc. Instn Radio Engrs, Aust.*, July 1954, Vol. 15, No. 7, pp. 174–177.) The discussion covers emission and filament failures in valves with pure tungsten filaments, thoriated tungsten filaments and oxide cathodes; glass failures in relation to operating temperatures; mechanical failures; and factors relating to handling and storage.

621.385 **3718**

Review of SER [AB Svenska Elektronrör] **Electron Tubes: Standard and Long-Life Types.**—S. Edsman & G. Lagerholm. (*Ericsson Rev.*, 1954, Vol. 31, No. 2, pp. 53–55.)

621.385.001.4 : 533.59 **3719**

New Method of Measuring Vacuum Factor of Vacuum Tubes in General.—A. Sato & Y. Ishii. (*Rep. elect. Commun. Lab., Japan*, Dec. 1953, Vol. 1, No. 4, pp. 19–21.) A refinement of Herold's a.c. method (486 of 1950) for direct measurement by means of a bridge circuit balancing ion and electron currents.

621.385.002.2 : 621.357 **3720**

Electrophoresis in the Valve Industry.—L. E. Grey & R. O. Jenkins. (*Electronic Engng*, Sept. 1954, Vol. 26, No. 319, pp. 402–405.) Electrophoresis is a process by which particles are deposited from a suspensoid by application of an electric field. Very careful control is required of impurities providing ions which form a charged double layer on the particles. Use of the process for coating filament cathodes and heaters and insulators is described.

621.385.029.6 **3721**

Amplification Measurements on a Velocity Step Tube.—N. B. Agdur. (*Chalmers tek. Högsk. Handl.*, 1954, No. 140, 10 pp.) Theory is developed for a single-beam valve with velocity modulation in a region of high direct voltage which is separated by a relatively short gap from a region of low direct voltage. Graphs show the theoretical variation of voltage amplification as a function of phase angle and the variation of maximum amplification with the length of the gap. Measurements were made on special tubes with fixed gaps much shorter than the length of the space-charge waves. Results are shown as curves of gain against voltage of the low-velocity region for given values of beam current and voltage of the high-velocity region.

621.385.029.6 : 621.396.822 **3722**

Theory of Noise in Travelling-Wave Valves.—E. I. Vasil'ev & V. M. Lopukhin. (*Zh. tekh. Fiz.*, May 1954, Vol. 24, No. 5, pp. 895–898.) The noise coefficient is calculated for a travelling-wave valve with helix, taking into account the thermal velocity of electrons in the beam. In the calculation the field of the steady component of the space charge is neglected, this corresponding to valves operating in a saturated state.

621.385.029.63/.64 + 538.566 : 537.56 **3723**

The Propagation of Electron Space-Charge Waves in Waveguides and Tubes with Periodic Structure.—O. E. H. Rydbeck & B. Agdur. (*Onde élect.*, June 1954, Vol. 34, No. 327, pp. 499–507. English version, *Chalmers tek. Högsk. Handl.*, 1954, No. 138, 20 pp.) Conditions necessary for space-charge-wave amplification in a cylindrical electron beam are determined, either the velocity or the diameter being varied at equally spaced points along the beam. Maximum gain expressed in decibels is a linear function of the square root of beam current density, and bandwidth is proportional to the gain. The theory is relevant to propagation in ionized gas as well as to travelling-wave valves.

621.385.029.63/.64 : 621.372 **3724**

Coupling of Modes in Helixes.—Pierce & Tien. (See 3451.)

621.385.029.64/.65 : 621.373.423 **3725**

Design of the Anode System of Unstrapped Magnetrons for the Millimetre-Wave Range.—

W. Praxmarer. (*NachrTech.*, April 1954, Vol. 4, No. 4, pp. 159–163.) Equivalent-circuit considerations for the unstrapped magnetron lead to an expression for the ratio between the anode diameter d_a and the wavelength λ. The dependence of the mode separation on this ratio is calculated and shown graphically for slot numbers up to $N = 16$. For $N = 14$ the greatest possible d_a/λ ratio is 2, at a mode separation $\sim 2\%$. The overall efficiency is $< 15\%$. The rising-sun type is also considered briefly.

621.385.029.64/.65 : 621.373.423 **3726**

The Wavelength Limit of the Rising-Sun [magnetron] **System and Comparison with the Unstrapped-Anode System.**—W. Praxmarer. (*NachrTech*, May 1954, Vol. 4, No. 5, pp. 197–199.) Theoretical and practical, mechanical, considerations of the rising-sun-type magnetron give a comparatively high lower wavelength limit of ~ 10 mm, assuming a maximal anode-diameter/wavelength ratio of 0·4. Other disadvantages of this type are the smaller power output and the limited choice of usable magnetic field strengths. Advantages over the unstrapped-anode magnetron include the large mode-separation and the higher efficiency ($\sim 25\%$ at 10 mm). See also 3725 above.

621.385.032.2 : 537.533 **3727**

Adiabatic Theory of an Electron Gun for Crossed-Field Devices.—J. Dain & I. A. D. Lewis. (*Proc. phys. Soc.*, 1st June 1954, Vol. 67, No. 414B, pp. 449–455.) "An electron gun is described capable of producing a ribbon-shaped beam of electrons moving under crossed electric and magnetic fields. The characteristics of the gun are derived by applying the adiabatic principle to motion in constant uniform crossed fields."

621.385.032.216 **3728**

Thermionic Cathodes made by Compression and Sintering of a Mixture of Metal Powders and Alkaline-Earth Compounds.—R. Uzan & G. Mesnard. (*C. R. Acad. Sci., Paris*, 9th Aug. 1954, Vol. 239, No. 6, pp. 484–486.) Directly heated ribbon cathodes have been prepared by methods previously described [2818 of September (Mesnard & Uzan)]. Cathodes made with Ni powder, sintered in vacuum and activated by heat and current, yielded > 1 A/cm^2 at 1250°K. Lower values of emission were obtained with W and with mixtures of W and Ni. Sintering in a H_2 atmosphere led to poor emission values for all cathodes containing W. Zr and Th were also tried.

621.385.15 **3729**

An Investigation of the Ultimate Performance of Space-Charge Deflection Tubes.—J. T. Wallmark. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1422–1427.) A comparison is made between the special electron-multiplier valve previously described (1477 of 1952) and conventional pentodes and electron multipliers of similar construction, in respect of noise, transconductance/current ratio, behaviour at h.f., stability of transconductance, and distortion.

621.385.2 **3730**

Effect of Filament Voltage on the Plate Current of a Diode.—H. S. C. Chen. (*J. appl. Phys.*, July 1954, Vol. 25, No. 7, pp. 929–930.) Comment on 1194 of 1953 (Ivey).

621.385.832 **3731**

The Formatron: an Electron Tube with a Predetermined Characteristic of Any Shape.—E. Labin. (*Onde élect.*, June & July 1954, Vol. 34, Nos. 327 & 328, pp. 518–524 & 614–621.) The term 'formatron' was suggested in 1942 for beam-deflection tubes, including the monoscope and ribbon-beam valves, in which the output is dependent on the position of the beam. This may be achieved by making use of the variation of secondary emission with angle of incidence of the primary beam, by interposing a slotted metal screen in the beam path, or by varying the width of the beam. Practical problems of design are discussed and various applications of the technique are illustrated.

621.387 **3732**

The Tacitron, a Low-Noise Thyratron capable of Current Interruption by Grid Action.—E. O. Johnson, J. Olmstead & W. M. Webster. (*Proc. Inst. Radio Engrs*, Sept. 1954, Vol. 42, No. 9, pp. 1350–1362.) The grid is designed to cause the discharge to take a form such that ions are produced only in the grid-anode region. As a result, the anode current can be switched on or off in about 1 μs by grid control alone. Details are given of an experimental valve with a current of 100 mA; the grid is relatively opaque, but the valve is otherwise very similar to conventional types. Theory of the operation is presented. Further possibilities of use in pulse circuits result from the improved characteristics.

621.38 **3733**

Thermionic Valves, their Theory and Design. [Book Review]—A. H. W. Beck. Publishers: Cambridge University Press, London, 570 pp., 60s. (*Brit. J. appl. Phys.*, June 1954, Vol. 5, No. 6, p. 229.) "The book is intended for graduate physicists and electrical engineers . . . the descriptive parts may be very valuable for considerably less qualified persons."

MISCELLANEOUS

061.4 : 621.396 **3734**

Farnborough 1954 : Radio at the S.B.A.C. Show.—(*Wireless World*, Oct. 1954, Vol. 60, No. 10, pp. 472–473.) Emphasis is on improvements to existing equipment rather than introduction of new equipment.

621.39 : 061.4 **3735**

21st National Radio Exhibition.—(*Wireless Engr*, Oct. 1954, Vol. 31, No. 10, pp. 276–281.) Review of the 1954 exhibition. Main attention is again devoted to television receivers; screen dimensions of 14–17 in. are usual. Valves and circuits for band-III reception are noted. For another account see *Wireless World*, Oct. 1954, Vol. 60, No. 10, pp. 478–493.

ABSTRACTS AND REFERENCES INDEX

The Index to the Abstracts and References published throughout 1954 is in course of preparation and will be supplied with the March 1955 issue. Subscribers will receive the Index automatically. As usual, a selected list of the journals scanned for abstracting, with publishers' addresses, will be included.